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DEVELOPMENT OF THERMAL STRATIFICATION AND DESTRATIFICATION SCALING CONCEPTS - VOLUME II

Stratification - Experimental Data

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FOREWORD

This document is Volume II of the final report on NASA Contract NAS8-24747, "Development of Thermal Stratification and Destratification Scaling Concepts." T. M. Lovrich, Program Manager, McDonnell Douglas Astronautics Company, performed the study for the George C. Marshall Space Flight Center of the National Aeronautics and Space Administration. The program was conducted under the technical direction of Mr. T. W. Winstead, Thermodynamics and Fluid Mechanics Branch, Propulsion Division, MSFC Propulsion and Vehicle Engineering Laboratory.

The author wishes to recognize Mr. L. A. Holmes, Engineering Instructor at Modesto Junior College in California, for initiating most of the initial scaling concepts analytical work and test design, and to Mr. T. W. Winstead, MSFC Contract Technical Supervisor, for his assistance during the performance of this research study.

The final report consists of two volumes:

Volume I	Definition of Thermal Stratification Scaling Parameters and Experimental Investigations
Volume II	Stratification—Experimental Data

Volume I is a report of the final results, conclusions, and recommendations of the study. It includes a presentation of the analytical methods used in defining the thermal stratification dimensionless scaling parameters and the experimental investigations performed with saturated Freon 113 PCA in three closed tanks geometrically scaled for determining the validity of these scaling parameters. Volume II contains a presentation of the experimental data collected and utilized in this stratification research study.

Work performed with the 6 inch and 18 inch diameter tanks was supported under this contract, while the work performed with a 12-inch-diameter tank was primarily supported by MDAC-West IRAD "Low-G Fluid Mechanics and Heat Transfer" funding.

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TABLES

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NOMENCLATURE

c_p	Specific heat at constant pressure
D	tank diameter
Fo	Fourier number, $\mu_\ell \, \theta / \rho_\ell \, D^2$
g	gravitational constant
Gr*	Modified Grashof number, $g \, \beta \, q'' \, L^4 / k \nu^2$
Gr^*_H	Modified Grashof number based on q''_H (e. g., theoretical Grashof number)
Gr^*_ℓ	(Gr^*_{Fluid}) Modified Grashof number based on q''_ℓ (i. e., q''_{fluid})
H	tank height
h_{fg}	latent heat of vaporization
I	Interface number, $q'' \, DC_p / h_{fg} \, k_\ell$
k	Thermal conductivity
L	liquid height
m	mass
p	pressure
Pr	Prandtl number, $\mu c_p / k$
q''	heat flux
q''_H	heat flux
q''_ℓ	(q''_{fluid}) heat flux to liquid
q''_u	heat flux to ullage
t	time
T	temperature
$\overline{Y}$	distance from bottom of tank

Greek Symbols

β	coefficient of thermal expansion
θ	stratification test period
μ	viscosity
ν	kinematic viscosity, μ/ρ
ρ	density
τ	dimensionless time, t/θ

Section 1
INTRODUCTION

This volume of the final report contains temperature and pressure data obtained from the saturated Freon 113 PCA closed-tank stratification tests conducted during this study. These data are documented to provide the detailed stratification test data from which the analytical procedures and conclusions in Volume I were obtained, and to furnish data for further analyses as required.

The data presented in tabular form are the test conditions, sensible heat values, and Freon 113 PCA liquid and ullage (vapor) properties for the 37 tests conducted in this program. Also included, are graphical representations of the liquid and ullage temperature and delta-temperature profiles, ullage and liquid bulk temperature and pressure histories, and dimensionless liquid-ullage delta-temperature profiles. The Modified Grashof numbers (Gr^*_H and Gr^*_ℓ) and Fourier number-history data are also presented graphically.

Section 2

TEST MATRIX—HEATER AND THERMOCOUPLE LOCATIONS

The tests investigated in this program are identified in the Test Matrix shown in Table 2-1. Figures 2-1, 2-2, and 2-3 identify the test-tank wall heater arrangement, the tank wall and penetration structural thermocouple locations, and the ullage-liquid thermocouple positions on an internal tank rake, respectively. The liquid and ullage thermocouple locations relative to the tank height are given in Table 2-2.

Table 2-1

TEST MATRIX - FREON 113 (PCA)

Test Column #1		Test Column #2	Test Column #3
6 in. Dia Tank		12 in. Dia Tank	18 in. Dia Tank
8G - Acceleration	- 27G	1G	1G
1,000 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{15} TESTS #2, #12S		500 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{15} TESTS #30, #25	
1,000 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 10^{15} TESTS #3, #11S		500 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 10^{15} TESTS #31, #17	
700 Btu/hr ft^2 (L) 50% FILL Gr* = 10^{14} TESTS #9S, #15S		350 Btu/hr ft^2 (L) 50% FILL Gr* = 10^{14} TESTS #33, #32	
700 Btu/hr ft^2 (L+U) 50% FILL Gr* = 10^{14} TESTS #10S, [illegible]S		350 Btu/hr ft^2 (L+U) 50% FILL Gr* = 10^{14} TESTS #34, #35	
600 Btu/hr ft^2 (L) 87.5% FILL Gr* = 7 x 10^{14} TESTS #1, #5, #8S		300 Btu/hr ft^2 (L) 87.5% FILL Gr* = 7 x 10^{14} TESTS #20, #22	
600 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 7 x 10^{14} TESTS #4, #6		300 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 7 x 10^{14} TESTS #23, #28	
90 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{14} TEST #14		45 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{14} TESTS #26, #15	
90 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 10^{14} TEST #13		45 Btu/hr ft^2 (L+U) 87.5% FILL Gr* = 10^{14} TEST #27	
	2,230 Btu/hr ft^2 (L) 50% FILL Gr* = 10^{15} TEST #1S		748 Btu/hr ft^2 (L) 50% FILL Gr* = 10^{15} TESTS #BS, #D
	2,880 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{16} TEST #3S		960 Btu/hr ft^2 (L) 87.5% FILL Gr* = 10^{16} TEST #1S

NOTES:

- (L), (L+U) . . . Liquid, and Liquid + Ullage Heating.
- Tests horizontally across Table are scaling tests (i.e., tests having constant Modified Grashof no. Gr* = Gr^*_H = f (L = liquid depth)).
- "S" . . . S in tests number indicates no heating during destratification testing.

FIGURE 2-1.
WALL HEATER ARRANGEMENT

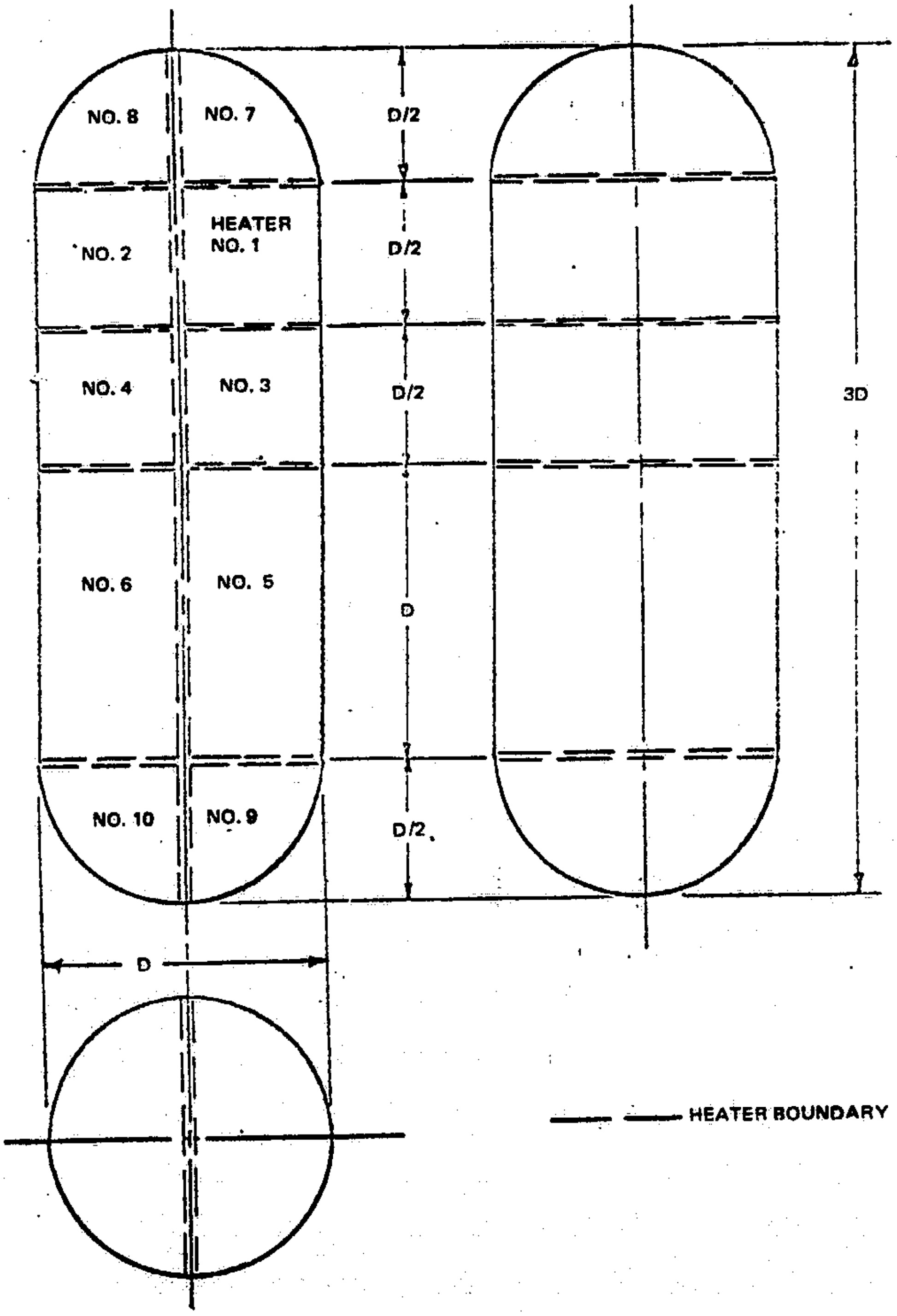


FIGURE 2-2.
TANK WALL AND PENETRATION THERMOCOUPLE LOCATIONS

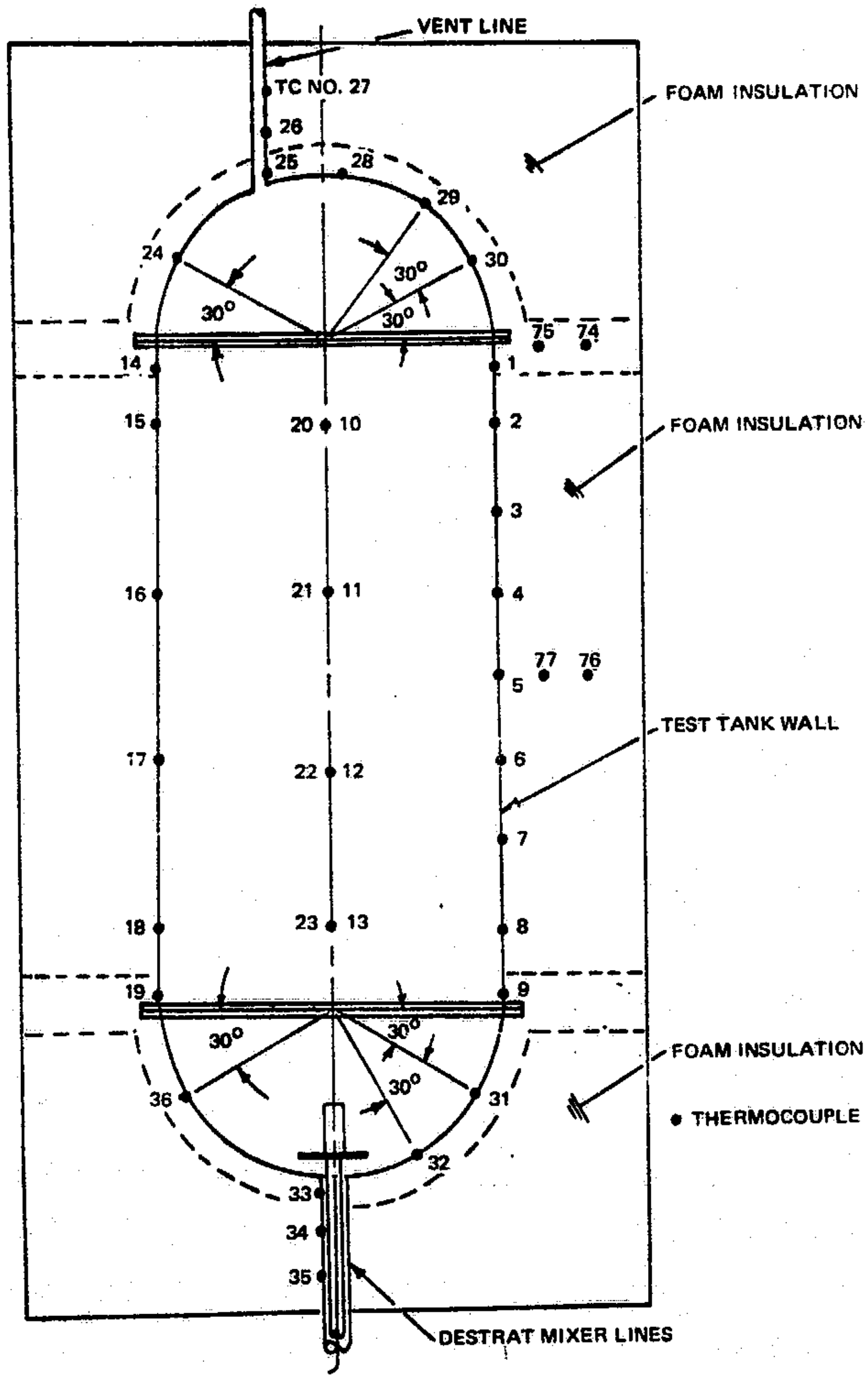
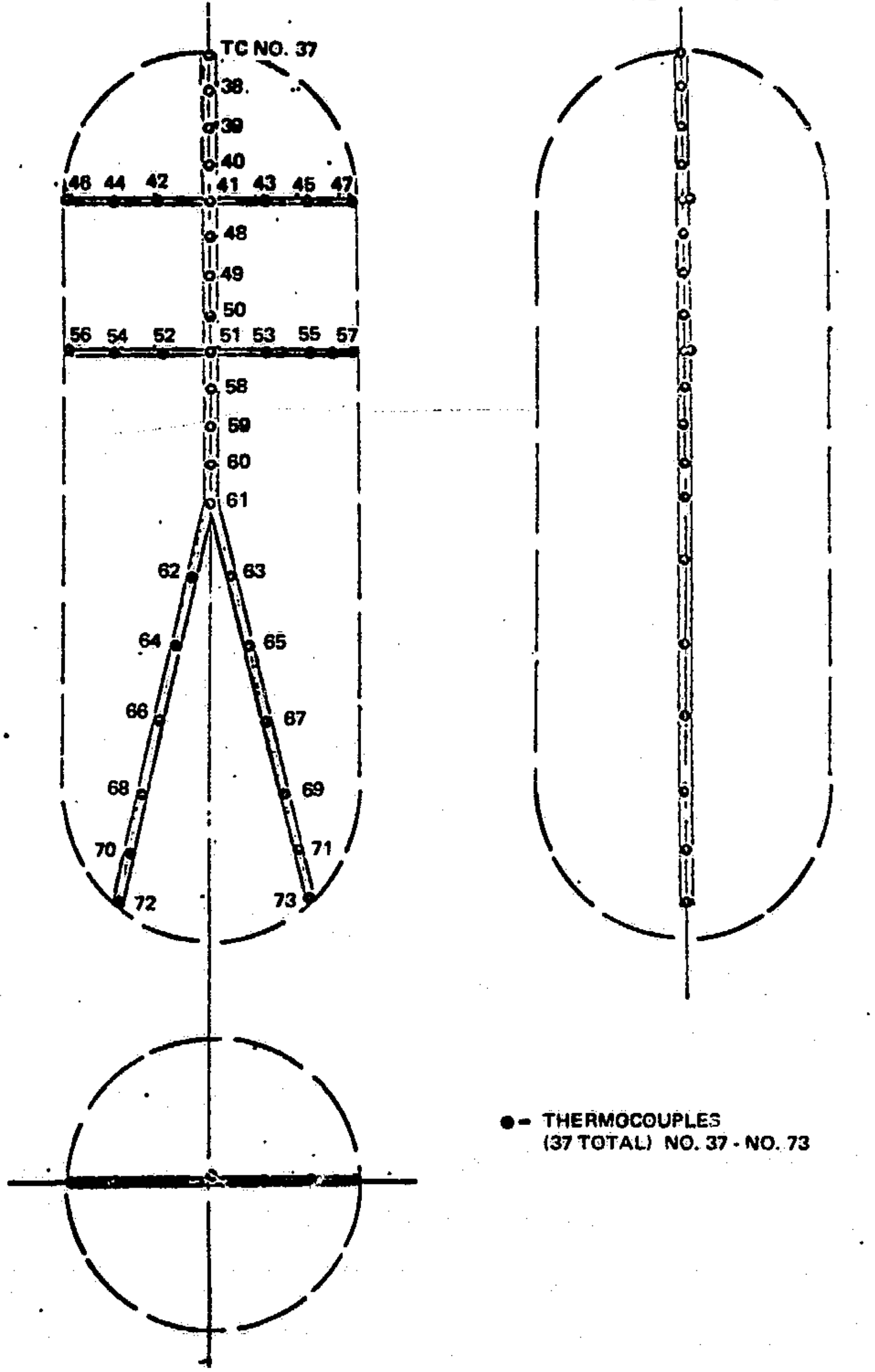


FIGURE 2-3.
LIQUID-ULLAGE RAKE THERMOCOUPLE LOCATIONS

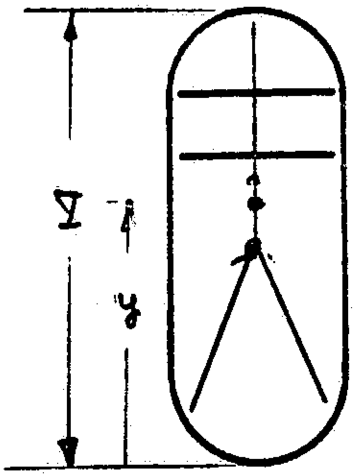


● – THERMOCOUPLES
(37 TOTAL) NO. 37 - NO. 73

Table 2-2

LIQUID-ULLAGE THERMOCOUPLE - NORMALIZED TANK HEIGHT RATIOS

Thermocouple No.	Normalized Tank Height (y/Y)
37	0.98
38	0.958
39	0.917
40	0.875
41-47	0.833
48	0.793
49	0.752
50	0.71
51-57	0.668
58	0.626
59	0.584
60	0.542
61	0.5
62-63	0.42
64-65	0.339
66-67	0.259
68-69	0.178
70-71	0.111
72-73	0.044



Section 3

TEST CONDITIONS AND TABULATED SENSIBLE HEAT DATA

This section contains the heat flux from the input heater, liquid (Freon 113 PCA) level, and stratification test time for each stratification test investigated. Included, are the tabulated sensible heat gains by the test liquid, ullage, and portion of the test tank structures; the tank wall; and silicone rubber heaters. This information is shown in Table 3-1.

Table 3

TEST CONDITIONS - SUPP
SENSIBLE HEAT GA

Test No.	6 in. 8G No. 9S	6 in. 8G No. 2	6 in. 8G No. 1
Liquid Level (percent)	50.0	87.5	87.5
Heating Condition	Liquid	Liquid	Liquid
Liquid Heater Electrical Source q''_H (Btu/hr ft^2)	701.569	1001.99	600.85
Ullage Heater Electrical Source q''_H (Btu/hr ft^2)	0.0	0.0	0.0
Stratification Test Time (minute)	3.33	2.0	3.666
Liquid Total Energy Supplied (Btu)	45.913	65.58	71.966
Ullage Total Energy Supplied (Btu)	0.0	0.0	0.0
Summation – Total Energy Supplied (Btu)	45.913	65.58	71.966
Liquid – Measured Heat Flux q''_ℓ (Btu/hr ft^2)	368.248	582.284	389.008
Ullage – Measured Heat Flux q''_u (Btu/hr ft^2)	1.744	2.566	1.604
Tank – Stainless Wall – Measured Sensible Heat (Btu)	6.089	7.867	7.244
Silicone Heaters – Measured Sensible Heat (Btu)	4.384	5.89	5.42
Foam Insulation – Measured Sensible Heat (Btu)	8.675	9.095	9.233
Freon 113 (PCA – Measured Sensible Heat (Btu)	24.102	38.11	46.669
Ullage – Measured Sensible Heat (Btu)	0.114	0.034	0.038
Summation – Measured Absorbed Sensible Heat (Btu)	43.364	60.996	68.604
Percent – Measured Absorbed Heat/Total Energy Supplied	94.44	93.01	95.32

Test No.	12 in. 1G No. 25	12 in. 1G No. 32	12 in. 1G No. 22
Liquid Level (percent)	87.5	50.0	87.5
Heating Condition	Liquid	Liquid	Liquid
Liquid Heater Electrical Source q''_H (Btu/hr ft^2)	500.56	349.77	300.077
Ullage Heater Electrical Source q''_H (Btu/hr ft^2)	0.0	0.0	0.0
Stratification Test Time (minute)	8.0	13.0	15.0
Liquid Total Energy Supplied (Btu)	524.188	357.123	589.2
Ullage Total Energy Supplied (Btu)	0.0	0.0	0.0
Summation – Total Energy Supplied (Btu)	524.188	357.123	589.2
Liquid – Measured Heat Flux q''_ℓ (Btu/hr ft^2)	328.14	206.34	214.021
Ullage – Measured Heat Flux q''_u (Btu/hr ft^2)	1.194	0.723	0.767
Tank – Stainless Wall – Measured Sensible Heat (Btu)	64.858	47.752	61.65
Silicone Heaters – Measured Sensible Heat (Btu)	23.58	16.912	22.237
Foam Insulation – Measured Sensible Heat (Btu)	72.78	67.448	72.869
Freon 113 PCA – Measured Sensible Heat (Btu)	343.629	210.677	420.229
Ullage – Measured Sensible Heat (Btu)	0.25	0.738	0.301
Summation – Measured Absorbed Sensible Heat (Btu)	505.097	342.789	577.286
Percent – Measured Absorbed Heat/Total Energy Supplied	96.35	95.98	97.97

Table 3-1

NS - SUPPLIED HEAT FLUXES - HEAT GAINS (Page 1 of 2)

6 in. 8G No. 1	6 in. 8G No. 14	6 in. 8G No. 10S	6 in. 8G No. 3	6 in. 8G No. 4	6 in. 8G No. 13	6 in. 27G No. 1S	6 in. 27G No. 3S
87.5	87.5	50.0	87.5	97.5	87.5	50.0	87.5
Liquid	Liquid	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid	Liquid
600.85	90.127	701.569	1001.99	600.85	90.127	2236.686	2884.422
0.0	0.0	701.569	1001.99	600.85	90.127	0.0	0.0
3.666	25.0	2.333	2.0	3.75	25.0	1.0	1.0
71.966	73.735	32.142	65.58	73.735	73.735	43.917	94.392
0.0	0.0	32.142	13.116	14.747	14.747	0.0	0.0
71.966	73.735	64.284	78.696	88.482	88.482	43.917	94.392
389.008	51.382	419.734	620.367	386.81	59.366	1529.462	1880.114
1.604	0.249	14.206	10.772	8.338	0.809	5.611	8.264
7.244	5.421	18.8	15.867	15.067	8.756	5.91	10.355
5.42	3.892	13.396	9.65	9.049	5.612	4.146	7.8
9.233	9.116	12.54	11.16	11.099	10.219	8.949	10.438
46.669	42.037	19.23	40.603	47.469	48.569	29.031	61.527
0.038	0.041	0.465	0.141	0.206	0.132	0.107	0.054
68.604	60.507	64.431	77.421	89.89	73.288	48.143	90.174
95.32	82.06	104.27	98.37	93.68	82.82	109.62	95.53

12 in. 1G No. 22	12 in. 1G No. 15	12 in. 1G No. 33	12 in. 1G No. 17	12 in. 1G No. 28	18 in. 1G No. D
87.5	87.5	50.0	87.5	87.5	50.0
Liquid	Liquid	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid
300.077	45.012	349.77	500.56	300.077	753.15
0.0	0.0	350.35	500.56	300.424	0.0
15.0	99.0	9.0	8.0	15.0	9.0
589.2	583.31	247.239	524.188	589.2	1197.835
0.0	0.0	247.648	104.84	117.976	0.0
589.2	583.31	494.887	629.028	707.176	1197.835
214.021	29.444	223.179	349.47	223.311	409.627
0.767	0.101	7.55	5.763	5.844	1.639
61.65	39.912	168.205	109.404	125.084	201.998
22.237	14.22	60.041	34.077	37.234	49.189
72.869	68.84	105.571	86.48	89.537	238.016
420.229	381.562	157.756	365.964	438.47	651.483
0.301	0.262	5.336	1.207	2.295	2.607
577.286	504.796	496.909	597.132	692.62	1143.293
97.97	86.53	100.4	94.92	97.94	95.44

FOLDOUT FRAME 2

Table 3-

TEST CONDITIONS - SUPPL
SENSIBLE HEAT GAI

Test No.	6 in. 8G No. 15S	6 in. 8G No. 12S	6 in. 8G No. 5
Liquid Level (percent)	50.0	87.5	87.5
Heating Condition	Liquid	Liquid	Liquid
Liquid Heater Electrical Source q''_H (Btu/hr ft^2)	701.57	1001.99	600.85
Ullage Heater Electrical Source q''_H (Btu/hr ft^2)	0.0	0.0	0.0
Stratification Test Time (minute)	3.333	2.0	3.667
Liquid Total Energy Supplied (Btu)	45.92	65.58	72.095
Ullage Total Energy Supplied (Btu)	0.0	0.0	0.0
Summation – Total Energy Supplied (Btu)	45.917	65.58	72.095
Liquid – Measured Heat Flux q''_ℓ (Btu/hr ft^2)	395.894	603.703	387.535
Ullage – Measured Heat Flux q''_u (Btu/hr ft^2)	1.903	2.952	1.8
Tank – Stainless Wall – Measured Sensible Heat (Btu)	6.222	8.044	7.467
Silicone Heaters – Measured Sensible Heat (Btu)	4.464	5.977	5.523
Foam Insulation – Measured Sensible Heat (Btu)	8.827	9.267	9.263
Freon 113 PCA – Measured Sensible Heat (Btu)	25.911	39.512	46.5
Ullage – Measured Sensible Heat (Btu)	0.125	0.039	0.043
Summation – Measured Absorbed Sensible Heat (Btu)	45.549	62.839	68.796
Percent – Measured Absorbed Heat/Total Energy Supplied	99..19	95.82	95.42

Test No.	12 in. 1G No. 33	12 in. 1G No. 30	12 in. 1G No. 20
Liquid Level (percent)	50.0	87.5	87.5
Heating Condition	Liquid	Liquid	Liquid
Liquid Heater Electrical Source q''_H (Btu/hr ft^2)	349.77	500.56	300.077
Ullage Heater Electrical Source q''_H (Btu/hr ft^2)	0.0	0.0	0.0
Stratification Test Time (minute)	13.0	8.0	15.0
Liquid Total Energy Supplied (Btu)	357.123	524.188	589.2
Ullage Total Energy Supplied (Btu)	0.0	0.0	0.0
Summation – Total Energy Supplied (Btu)	357.123	524.188	589.2
Liquid – Measured Heat Flux q''_ℓ (Btu/hr ft^2)	208.707	362.662	205.171
Ullage – Measured Heat Flux q''_u (Btu/hr ft^2)	0.657	1.192	0.74
Tank – Stainless Wall – Measured Sensible Heat (Btu)	41.338	64.858	59.513
Silicone Heaters – Measured Sensible Heat (Btu)	14.729	23.568	21.484
Foam Insulation – Measured Sensible Heat (Btu)	66.745	73.774	77.077
Freon 113 PCA – Measured Sensible Heat (Btu)	213.093	314.63	402.851
Ullage – Measured Sensible Heat (Btu)	0.671	0.250	0.291
Summation – Measured Absorbed Sensible Heat (Btu)	336.576	477.08	561.216
Percent – Measured Absorbed Heat/Total Energy Supplied	94.24	91.01	95.25

Table 3-1

NS - SUPPLIED HEAT FLUXES -
HEAT GAINS (Page 2 of 2)

6 in. 8G No. 5	6 in. 8G No. 16S	6 in. 8G No. 11S	6 in. 8G No. 6	6 in. 8G No. 8S	6 in. 1G No. 1	6 in. 1G No. 2
87.5	50.0	87.5	87.5	87.5	87.5	87.5
Liquid	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage
600.85	701.569	1001.99	600.85	600.85	600.85	600.85
0.0	701.569	1001.99	600.85	0.0	0.0	0.0
3.667	2.333	2.0	3.8	3.667	3.7	3.7
72.095	32.142	65.58	74.718	72.095	72.752	72.752
0.0	32.142	13.116	14.944	0.0	0.0	0.0
72.095	64.284	78.696	89.662	72.095	72.752	72.752
387.535	436.428	635.42	408.07	381.824	375.963	370.305
1.8	10.662	10.178	9.723	1.517	1.356	1.594
7.467	19.823	15.645	15.912	6.978	8.4	8.488
5.523	14.182	9.535	9.607	5.167	6.266	6.233
9.263	12.896	11.26	11.375	9.031	9.633	9.758
46.5	19.995	41.588	50.745	45.815	45.522	44.837
0.043	0.488	0.133	0.242	0.036	0.033	0.039
68.796	67.384	78.161	87.881	67.027	69.854	69.355
95.42	104.82	99.32	98.01	92.97	96.01	95.33

12 in. 1G No. 20	12 in. 1G No. 26	12 in. 1G No. 34	12 in. 1G No. 31	12 in. 1G No. 23	12 in. 1G No. 27	18 in. 1G No. BS	18 in. 1G No. IS
87.5	87.5	50.0	87.5	87.5	87.5	50.0	87.5
Liquid	Liquid	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid and Ullage	Liquid	Liquid
300.077	45.012	349.772	500.563	300.077	45.0116	753.151	965.0435
0.0	0.0	350.35	500.563	300.424	45.0637	0.0	0.0
15.0	99.0	9.0	8.0	15.0	99.0	9.0	9.0
589.2	583.308	247.239	524.188	589.2	583.308	1197.835	2558.06
0.0	0.0	247.239	104.838	117.976	116.797	0.0	0.0
589.2	583.308	494.887	629.026	707.176	700.105	1197.835	2558.06
205.171	30.664	237.126	350.637	247.854	34.946	400.823	578.124
0.74	0.102	7.69	7.732	5.459	0.472	1.723	2.73
59.513	40.625	162.86	128.648	126.866	73.411	206.696	302.998
21.484	14.514	57.597	38.45	37.778	22.89	49.245	74.144
77.077	75.495	103.787	90.176	90.516	77.084	243.66	276.177
402.851	397.382	167.614	367.186	486.661	452.867	637.481	1532.445
0.291	0.264	5.436	1.619	2.144	1.223	2.740	1.447
561.216	528.28	497.294	626.079	743.965	627.475	1139.822	2187.211
95.25	90.56	100.48	99.53	105.2	89.62	95.15	85.5

Section 4

LIQUID AND ULLAGE (VAPOR) PROPERTIES

This section contains the test liquid (Freon 113 PCA) and ullage thermodynamic properties, and the characteristic temperature and pressures for each test investigated. Also shown, are the values for the three scaling parameters that were maintained constant for the scaling tests in this study. These parameters are the Modified Grashof number (Gr^*), the Fourier number (Fo), and the Interface number (I). This information is shown in Table 4-1.

Notes:

$\tau = 1$ Normalized time at end of stratification test.

CHTMP Characteristic temperature, $(q''_H D/k_\ell)$

CHPRESS Characteristic pressure, $(q''_H \theta/D)$

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Table 4-1

FREON 113 PCA LIQUID - ULLAGE PROPERT

Test No.	6 in. 8G #9S	6 in. 8G #2	6 in. 8G #1	6 in. 8G #14	6 in. 8G
Characteristic Temperature (CHTMP) (°F)	8.861 + 03	1.267 + 04	7.595 + 03	1.140 + 03	8.867 + 03
Characteristic Pressure (CHPRESS) (lb_f/in^2)	4.211 + 02	3.609 + 02	3.96 + 02	4.058 + 02	2.948 + 02
LIQUID: density (lb/ft^3)	94.431 - 93.656	94.382 - 93.681	94.387 - 93.529	94.335 - 93.562	94.394 - 93.
mass (lb)	12.361 - 12.259	21.621 - 21.46	21.622 - 21.425	21.61 - 21.433	12.356 - 12.
specific heat (Btu/lb °F)	0.225 - 0.227	0.225 - 0.227	0.225 - 0.227	0.225 - 0.227	0.225 - 0.22
thermal conductivity (Btu/hr ft °F)	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039
viscosity (lb/ft hr)	1.202 - 1.137	1.198 - 1.139	1.198 - 1.127	1.194 - 1.13	1.199 - 1.14
kinematic viscosity (ft^2/hr)	0.012732 - 0.012139	0.01269 - 0.01216	0.012696 - 0.012049	0.01265 - 0.01207	0.0127 - 0.0
Prandtl No.	6.834 - 6.6116	6.819 - 6.6185	6.82 - 6.578	6.805 - 6.587	6.822 - 6.64
Modified Grashof No. = $f(q''_H, \tau = 1.)$, Gr^*_H	1.222 + 14	1.342 + 15	8.217 + 14	1.228 + 14	1.202 + 14
Modified Grashof No. = $f(q''_\ell, \tau = 1.)$, Gr^*_ℓ	6.412 + 13	7.8 + 14	5.32 + 14	6.999 + 13	7.193 + 13
Interface No., I	0.03106	0.0218	0.0363	0.242	0.03106
ULLAGE: density (lb/ft^3)	0.451 - 0.531	0.453 - 0.546	0.454 - 0.559	0.455 - 0.566	0.464 - 0.74
mass (lb)	0.059 - 0.07	0.015 - 0.018	0.015 - 0.018	0.015 - 0.019	0.061 - 0.09
specific heat (Btu/lb °F)	0.158 - 0.16	0.158 - 0.16	0.158 - 0.16	0.158 - 0.16	0.159 - 0.16

Test No.	6 in. 27G #3S	12 in. 1G #25	12 in. 1G #32	12 in. 1G #22	12 in. 1G
Characteristic Temperature (CHTMP) (°F)	3.662 + 04	1.267 + 04	8.861 + 03	7.6 + 03	1.14 + 03
Characteristic Pressure (CHPRESS) ($lb_f/in.^2$)	5.195 + 02	3.606 + 02	4.094 + 02	4.053 + 02	4.013 + 02
LIQUID: density (lb/ft^3)	94.139 - 93.009	94.32 - 93.53	93.42 - 92.39	94.31 - 93.34	94.293 - 93.
mass (lb)	21.565 - 21.306	172.85 - 171.41	97.83 - 96.755	172.83 - 171.06	172.8 - 171.
specific heat (Btu/lb °F)	0.226 - 0.229	0.225 - 0.227	0.228 - 0.231	0.225 - 0.228	0.225 - 0.22
thermal conductivity (Btu/hr ft °F)	0.039	0.040 - 0.039	0.039 - 0.038	0.04 - 0.039	0.039
viscosity (lb/ft hr)	1.177 - 1.088	1.193 - 1.127	1.119 - 1.044	1.191 - 1.113	1.19 - 1.11
kinematic viscosity (ft^2/hr)	0.0125 - 0.01169	0.01264 - 0.01205	0.01197 - 0.0113	0.01263 - 0.01192	0.01262 - 0
Prandtl No.	6.746 - 6.4478	6.8 - 6.579	6.55 - 6.308	6.8 - 6.53	6.792 - 6.5
Modified Grashof No. = $f(q''_H, \tau = 1.)$, Gr^*_H	1.431 + 16	1.37 + 15	1.26 + 14	8.422 + 14	1.251 + 14
Modified Grashof No. = $f(q''_\ell, \tau = 1.)$, Gr^*_ℓ	9.324 + 15	8.978 + 14	7.431 + 13	6.007 + 14	8.186 + 13
Interface No., I	0.00756	0.0218	0.03118	0.03633	0.2423
ULLAGE: density (lb/ft^3)	0.451 - 0.594	0.459 - 0.546	0.451 - 0.516	0.455 - 0.559	0.458 - 0.5
mass (lb)	0.015 - 0.019	0.12 - 0.143	0.472 - 0.541	0.119 - 0.146	0.12 - 0.14
specific heat (Btu/lb °F)	0.158 - 0.16	0.159 - 0.16	0.158 - 0.159	0.158 - 0.16	0.159 - 0.1

Table 4-1

D - ULLAGE PROPERTIES (Page 1 of 2)

	6 in. 8G #14	6 in. 8G #10S	6 in. 8G #3	6 in. 8G #4	6 in. 8G #13	6 in. 27G #1S
	1, 140 + 03	8, 867 + 03	1. 267 + 04	7, 598 + 03	1. 14 + 03	2. 838 + 04
	4. 058 + 02	2. 948 + 02	3. 609 + 02	4. 058 + 02	4. 058 + 02	4. 028 + 02
9	94. 335 - 93. 562	94. 394 - 93. 775	94. 364 - 93. 618	94. 364 - 93. 491	93. 449 - 93. 66	94. 174 - 93. 241
5	21. 61 - 21. 433	12. 356 - 12. 275	21. 616 - 21. 445	21. 616 - 21. 416	21. 407 - 21. 455	12. 327 - 12. 205
	0. 225 - 0. 227	0. 225 - 0. 227	0. 225 - 0. 227	0. 225 - 0. 228	0. 228 - 0. 227	0. 226 - 0. 228
	0, 04 - 0. 039	0. 04 - 0. 039	0, 04 - 0, 039	0. 04 - 0. 039	0. 039	0. 039
	1. 194 - 1. 13	1. 199 - 1. 147	1. 196 - 1. 134	1. 196 - 1. 124	1. 121 - 1. 137	1. 18 - 1. 105
12049	0. 01265 - 0. 01207	0. 0127 - 0. 012226	0. 012678 - 0. 012112	0. 012678 - 0. 012022	0. 01199 - 0. 01214	0. 01253 - 0. 01185
	6. 805 - 6. 587	6, 822 - 6, 644	6. 813 - 6. 60145	6, 813 - 6. 568	6. 557 - 6. 6126	6. 757 - 6. 504
	1, 228 + 14	1, 202 + 14	1. 354 + 15	8. 262 + 14	1. 247 + 14	1. 394 + 15
	6, 999 + 13	7. 193 + 13	8. 385 + 14	5. 319 + 14	8, 211 + 13	9. 531 + 14
	0. 242	0. 03106	0. 0218	0. 0363	0. 242	0. 00977
	0. 455 - 0. 566	0. 464 - 0. 741	0. 456 - 0. 782	0. 458 - 0. 902	0. 456 - 0. 765	0. 461 - 0. 536
	0, 015 - 0. 019	0. 061 - 0, 097	0. 015 - 0. 026	0. 015 - 0. 03	0. 015 - 0. 025	0. 06 - 0. 07
	0. 158 - 0. 16	0. 159 - 0. 162	0. 158 - 0. 162	0. 159 - 0. 163	0. 158 - 0. 162	0. 159 - 0. 16
32	12 in. 1G #22	12 in. 1G #15	12 in. 1G #35	12 in. 1G #17	12 in. 1G #28	18 in. 1G #D
	7. 6 + 03	1, 14 + 03	8, 851 + 03	1. 268 + 04	7. 597 + 03	2. 859 + 04
	4. 053 + 02	4. 013 + 02	2. 835 + 02	3. 606 + 02	4. 053 + 02	4. 069 + 02
	94. 31 - 93. 34	94. 293 - 93. 416	94. 34 - 93. 7	94. 29 - 93. 449	94. 306 - 93. 299	94. 326 - 93. 55
5	172. 83 - 171. 06	172. 8 - 171. 19	98. 79 - 98. 122	172. 795 - 171. 254	172. 825 - 170. 979	333. 377 - 330. 633
	0. 225 - 0. 228	0. 225 - 0. 228	0. 225 -0. 227	0. 225 - 0. 228	0. 225 - 0. 228	0. 225 - 0. 227
	0. 04 - 0. 039	0. 039	0. 04 - 0. 039	0. 039	0. 039	0. 040 - 0. 039
	1. 191 - 1. 113	1. 19 - 1. 118	1. 194 - 1. 14	1. 19 - 1. 121	1. 191 - 1. 109	1. 193 - 1. 129
113	0. 01263 - 0. 01192	0. 01262 - 0. 01197	0. 01265 - 0. 01217	0. 01262 - 0. 01199	0. 01263 - 0. 01189	0. 01265 - 0. 01206
	6. 8 - 6. 53	6. 792 - 6. 549	6. 8 - 6. 623	6. 79 - 6. 557	6. 796 - 6. 519	6. 802 - 6. 584
	8. 422 + 14	1. 251 + 14	1. 212 + 14	1. 386 + 15	8. 473 + 14	1. 349 + 15
	6. 007 + 14	8. 186 + 13	7. 733 + 13	9. 673 + 14	6. 305 + 13	7. 335 + 14
	0. 03633	0. 2423	0. 03118	0. 0218	0. 03633	0. 00966
	0. 455 - 0. 559	0. 458 - 0. 549	0. 453 - 0. 827	0. 480 - 0. 828	0. 458 - 1. 037	0. 445 - 0. 513
	0. 119 - 0. 146	0. 12 - 0. 144	0. 474 - 0. 866	0. 126 - 0. 217	0. 120 - 0. 272	1. 572 - 1. 814
	0. 158 - 0. 16	0. 159 - 0. 16	0. 158 - 0. 163	0. 159 - 0. 163	0. 159 - 0. 164	0. 158 - 0. 159

Table 4-1
FREON 113 FCA LIQUID - ULLAGE PROPER

Test No.		6 in. 8G #15S	6 in. 8G # 12S	6 in. 8G #5	6 in. 8G #16S	6 in. 8G
Characteristic Temperature (CHTMP) (°F)		8.88 + 03	1.269 + 04	7.592 + 03	8.868 + 03	1.2654 + 04
Characteristic Pressure (CHPRESS) (lb_f/in^2)		4.212 + 02	3.609 + 02	3.968 + 02	2.948 + 02	3.609 + 02
LIQUID:	density (lb/ft^3)	94.314 - 93.48	94.282 - 93.556	94.411 - 93.556	94.392 - 93.749	94.457 - 93.
	mass (lb)	12.346 - 12.237	21.598 - 21.431	21.627 - 21.431	12.356 - 12.272	21.638 - 21
	specific heat (Btu/lb °F)	0.225 - 0.228	0.225 - 0.227	0.225 - 0.227	0.225 - 0.227	0.225 - 0.22
	thermal conductivity (Btu/hr ft °F)	0.04 - 0.039	0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039
	viscosity (lb/ft hr)	1.192 - 1.123	1.189 - 1.129	1.201 - 1.129	1.199 - 1.144	1.205 - 1.1
	kinematic viscosity (ft^2/hr)	0.01264 - 0.01201	0.012613 - 0.012068	0.012716 - 0.012068	0.0127 - 0.01221	0.01275 - 0
	Prandtl No.	6.798 - 6.565	6.79 - 6.585	6.827 - 6.585	6.823 - 6.636	6.84 - 6.62
	Modified Grashof No. = $f(q''_H, \tau = 1.)$, Gr^*_H	1.253 + 14	1.367 + 15	8.185 + 14	1.207 + 14	1.339 + 15
	Modified Grashof No. = $f(q''_\ell, \tau = 1.)$, Gr^*_ℓ	7.069 + 13	8.235 + 14	5.279 + 14	7.506 + 13	8.493 + 14
	Interface No., I	0.03106	0.0218	0.0363	0.03106	0.0218
ULLAGE:	density (lb/ft^3)	0.46 - 0.547	0.458 - 0.564	0.451 - 0.568	0.456 - 0.745	0.456 - 0.7
	mass (lb)	0.06 - 0.072	0.015 - 0.018	0.015 - 0.019	0.06 - 0.098	0.015 - 0.0
	specific heat (Btu/lb °F)	0.159 - 0.16	0.159 - 0.16	0.158 - 0.16	0.158 - 0.162	0.158 - 0.1

Test No.		12 in. 1G #33	12 in. 1G #30	12 in. 1G #20	12 in. 1G #26	12 in. 1
Characteristic Temperature (CHTMP) (°F)		8.859 + 03	1.267 + 04	7.599 + 03	1.14 + 03	8.858 + 03
Characteristic Pressure (CHPRESS) ($lb_f/in.^2$)		4.094 + 02	3.606 + 02	4.053 + 02	4.013 + 02	2.835 + 02
LIQUID:	density (lb/ft^3)	94.282 - 93.426	94.309 - 93.517	94.27 - 93.364	94.295 - 93.382	94.287 - 93
	mass (lb)	98.732 - 97.835	172.83 - 171.378	172.795 - 171.099	172.805 - 171.132	98.738 - 9
	specific heat (Btu/lb °F)	0.225 - 0.228	0.225 - 0.227	0.225 - 0.228	0.225 - 0.228	0.225 - 0.
	thermal conductivity (Btu/hr ft °F)	0.039	0.040 - 0.039	0.039	0.039	0.039
	viscosity (lb/ft hr)	1.189 - 1.119	1.191 - 1.126	1.19 - 1.114	1.19 - 1.115	1.19 - 1.1
	kinematic viscosity (ft^2/hr)	0.01261 - 0.01254	0.01263 - 0.01204	0.01262 - 0.01193	0.01262 - 0.01194	0.01262 -
	Prandtl No.	6.789 - 6.551	6.797 - 6.575	6.791 - 6.535	6.793 - 6.54	6.79 - 6.6
	Modified Grashof No. = $f(q''_H, \tau = 1.)$, Gr^*_H	1.259 + 14	1.373 + 15	8.401 + 14	1.257 + 14	1.227 + 14
	Modified Grashof No. = $f(q''_\ell, \tau = 1.)$, Gr^*_ℓ	7.511 + 13	9.024 + 14	5.744 + 14	8.563 + 13	8.319 + 13
	Interface No., I	0.03118	0.0218	0.03633	0.2423	0.03118
ULLAGE:	density (lb/ft^3)	0.46 - 0.520	0.46 - 0.547	0.454 - 0.554	0.454 - 0.545	0.463 - 0.
	mass (lb)	0.481 - 0.544	0.121 - 0.143	0.119 - 0.145	0.119 - 0.143	0.485 - 0.
	specific heat (Btu/lb °F)	0.159	0.159 - 0.160	0.158 - 0.16	0.158 - 0.16	0.159 - 0

FOLDOUT FRAME 1

Table 4-1

- ULLAGE PROPERTIES (Page 2 of 2)

6 in. 8G #16S	6 in. 8G #11S	6 in. 8G #6	6 in. 8G #8S	6 in. 1G #1	6 in. 1G #2	
8.868 + 03	1.2654 + 04	7.603 + 03	7.581 + 03	7.596 + 03	7.605 + 03	
2.948 + 02	3.609 + 02	4.112 + 02	3.968 + 02	4.004 + 02	4.004 + 02	
94.392 - 93.749	94.457 - 93.692	94.327 - 93.394	94.493 - 93.651	94.38 - 93.544	94.315 - 93.491	
12.356 - 12.272	21.638 - 21.463	21.608 - 21.394	21.646 - 21.453	21.62 - 21.428	21.6 - 21.416	
.225 - 0.227	0.225 - 0.227	0.225 - 0.228	0.225 - 0.227	0.225 - 0.227	0.225 - 0.228	
.04 - 0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039	0.04 - 0.039	
.199 - 1.144	1.205 - 1.14	1.193 - 1.116	1.208 - 1.137	1.198 - 1.128	1.192 - 1.124	
.0127 - 0.01221	0.01275 - 0.012166	0.01265 - 0.01195	0.01278 - 0.01214	0.01269 - 0.01206	0.01264 - 0.01202	
.822 - 6.636	6.84 - 6.621	6.802 - 6.543	6.852 - 6.61	6.818 - 6.582	6.799 - 6.568	
.207 + 14	1.339 + 15	8.373 + 14	8.073 + 14	1.025 + 14	1.033 + 14	
.506 + 13	8.493 + 14	5.687 + 14	5.13 + 14	6.415 + 13	6.368 + 13	
.03106	0.0218	0.0363	0.0363	0.0363	0.0363	
.456 - 0.745	0.456 - 0.767	0.458 - 0.764	0.453 - 0.554	0.449 - 0.54	0.455 - 0.561	
06 - 0.098	0.015 - 0.025	0.015 - 0.032	0.015 - 0.018	0.015 - 0.018	0.015 - 0.018	
158 - 0.162	0.158 - 0.162	0.159 - 0.164	0.158 - 0.16	0.158 - 0.16	0.158 - 0.16	

12 in. 1G #26	12 in. 1G #34	12 in. 1G #31	12 in. 1G #23	12 in. 1G #27	18 in. 1G #BS	18 in. 1G #IS
14 + 03	8.858 + 03	1.267 + 04	7.594 + 03	1.14 + 03	2.863 + 04	3.668 + 04
013 + 02	2.835 + 02	3.606 + 02	4.053 + 02	4.013 + 02	4.069 + 02	5.214 + 02
.295 - 93.382	94.287 - 93.613	93.462 - 92.58	94.333 - 93.215	94.276 - 93.236	94.253 - 93.493	94.261 - 93.218
2.805 - 171.132	98.738 - 98.032	171.278 - 169.662	172.874 - 170-826	172.769 - 170.863	333.117 - 330.432	583.006 - 576.556
225 - 0.228	0.225 - 0.227	0.228 - 0.23	0.225 - 0.228	0.225 - 0.228	0.225 - 0.228	0.225 - 0.228
039	0.039	0.039 - 0.038	0.04 - 0.039	0.039	0.039	0.039
19 - 1.115	1.19 - 1.134	1.122 - 1.057	1.194 - 1.103	1.189 - 1.104	1.187 - 1.124	1.187 - 1.103
01262 - 0.01194	0.01262 - 0.012109	0.012 - 0.01142	0.01265 - 0.01183	0.01261 - 0.01184	0.01259 - 0.01202	0.0126 - 0.01183
793 - 6.54	6.79 - 6.6	6.561 - 6.349	6.804 - 6.498	6.787 - 6.503	6.78 - 6.569	6.782 - 6.498
57 + 14	1.227 + 14	1.383 + 15	8.565 + 14	1.282 + 14	1.36 + 15	1.395 + 16
63 + 13	8.319 + 13	9.686 + 14	7.075 + 13	9.954 + 13	7.238 + 14	8.357 + 15
423	0.03118	0.0218	0.03633	0.2423	0.00966	0.00754
54 - 0.545	0.463 - 0.844	0.462 - 0.9	0.458 - 1.007	0.463 - 0.812	0.46 - 0.531	0.465 - 0.607
19 - 0.143	0.485 - 0.884	0.121 - 0.236	0.12 - 0.264	0.121 - 0.213	1.624 - 1.878	0.411 - 0.536
58 - 0.16	0.159 - 0.163	0.159 - 0.163	0.159 - 0.164	0.159 - 0.163	0.159 - 0.16	0.159 - 0.16

FOLDOUT FRAME 2

Section 5

EXPERIMENTAL TEMPERATURE, PRESSURE, AND COMPILED MODIFIED GRASHOF AND FOURIER NUMBERS DATA

This section is composed of the measured temperature and pressure data obtained during this program. The data are presented in sets corresponding to scaling tests in Sections 5.1 through 5.10. Scaled tests are represented by those tests listed in the same row of the test matrix (see Table 2-1). This represents tests where the dimensionless parameters, the Modified Grashof number Gr^*_H, the Fourier number Fo, and the liquid-vapor Interface number I defined in Volume I of this report, are held constant during each test. Three experimental variables were used to control the values of these dimensionless scaling parameters. These variables are the input heat flux q''_H, the stratification test time θ, and the applied gravitational constant g. The test data in Section 5.11 do not represent scaling tests, but tests with constant wall-heat flux q''_H. These two tests, 6-in.-dia. tank test 1g #1 and #2, have the same heat flux as the 6-in.-dia. tank test 8g #1 of Section 5.5.

The data from each set of scaling tests include:

(1) Structural geometric tank weights - wattmeter heat flux inputs.
(2) Stratification temperature (°F) data for each thermocouple and at each recorded time slice.
(3) Family of stratification temperature profile curves.
(4) Family of stratification del-temp profile curves.
(5) Family of stratification DT Norm (normalized del-temp) profile curves.
(6) Bulk ullage and liquid temperature histories.
(7) Tank pressure history.
(8) Liquid Modified-Grashof number histories - stratification.
(9) Liquid Fourier number history.

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During the test program, the heaters #1 and #2, #3 and #4, #5 and #6, #7 and #8, and #9 and #10 (i. e., Figure 2-1) were connected in parallel. Under item (1) above, the supplied heater heat-flux values to the respective parallel heaters are identified as H12, H34, H56, H78, and H910 in Tables 5. 1-1a through 5. 11-1b.

Section 5. 1

SCALING SET

6-in. -Dia Tank Tests	12-in. -Dia Tank Tests
8G	1G
Test #2	Test #30
Test #12S	Test #25

Table 5.1-1a. 6 IN. DIA TANK TEST 8G#2 (Page 1 of 2)

```
        STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708          FLNGE AREA FT2=    .0365
DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=     .00164        FLNGE VOL FT3=    .00076
DME MASS LBM=     .65596       MASS 1/2 CYL LBM=     .81996      FLANGE MASS=     .38058

 LIQ VOL FT3=    .22907        ULLAGE VOL FT3=     .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=1001.9935    H34=1001.9935    H56=1001.9935    H910=1001.9935    H78=    0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)=1001.9935
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=    0.0000
EST.HT INPUT LIQ(STRAT)BTU=    65.580       (STRAT+DESTRAT)BTU=   120.012
EST.LIQ TEMP INCRSE(STRAT)=    13.4616F       (STRAT+DESTRAT)=    24.6168F

EST.HT INPUT ULLAGE(STRAT)BTU=      0.000       (STRAT+DESTRAT)BTU=      0.000
```

Table 5.1-1b. 6 IN. DIA TANK TEST 8G#12S

```
        STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708          FLNGE AREA FT2=    .0365
DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=     .00164        FLNGE VOL FT3=    .00076
DME MASS LBM=     .65596       MASS 1/2 CYL LBM=     .81996      FLANGE MASS=     .38058

 LIQ VOL FT3=    .22907        ULLAGE VOL FT3=     .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=1001.9935    H34=1001.9935    H56=1001.9935    H910=1001.9935    H78=    0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)=1001.9935
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=    0.0000
EST.HT INPUT LIQ(STRAT)BTU=    65.580       (STRAT+DESTRAT)BTU=     0.000
EST.LIQ TEMP INCRSE(STRAT)=    13.4594F       (STRAT+DESTRAT)=     0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=      0.000       (STRAT+DESTRAT)BTU=      0.000
```

Table 5.1-1c. 12 IN. DIA TANK TEST 1G#30 (Page 2 of 2)

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1.5708        CYL AREA FT2=  6.2832       FLNGE AREA FT2=   .1458
DME WALL VOL FT3=   .01047      1/2 CYL WALL VOLFT3=   .01309     FLNGE VOL FT3=    .00608
DME MASS LBM=  5.24772       MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

 LIQ VOL FT3=  1.83260        ULLAGE VOL FT3=    .26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 500.5626   H34= 500.5626   H56= 500.5626   H910= 500.5626   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 500.5626
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=  524.188      (STRAT+DESTRAT)BTU= 1179.423
EST.LIQ TEMP INCRSE(STRAT)=   13.4474F      (STRAT+DESTRAT)=   30.2103F

EST.HT INPUT ULLAGE(STRAT)BTU=     0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.1-1d. 12 IN. DIA TANK TEST 1G#25

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1.5708        CYL AREA FT2=  6.2832       FLNGE AREA FT2=   .1458
DME WALL VOL FT3=   .01047      1/2 CYL WALL VOLFT3=   .01309     FLNGE VOL FT3=    .00608
DME MASS LBM=  5.24772       MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

 LIQ VOL FT3=  1.83260        ULLAGE VOL FT3=    .26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 500.5626   H34= 500.5626   H56= 500.5626   H910= 500.5626   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 500.5626
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=  524.188      (STRAT+DESTRAT)BTU= 1572.564
EST.LIQ TEMP INCRSE(STRAT)=   13.4474F      (STRAT+DESTRAT)=   40.2445F

EST.HT INPUT ULLAGE(STRAT)BTU=     0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.1-2a. 6 IN. DIA TANK TEST 8G #2 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	,330	,660	1,000	1,330	1,660	2,000
TAP	0,000	,165	,330	,500	,665	,830	1,000
1	116,125	118,792	122,042	125,208	127,375	130,542	133,125
2	116,917	124,167	130,792	134,958	137,917	140,542	143,375
3	117,083	122,750	129,125	132,667	135,708	138,625	141,375
4	117,333	123,458	129,292	133,375	135,917	138,667	140,750
5	116,625	121,375	126,833	130,542	133,083	135,458	137,542
6	116,708	121,667	126,958	130,458	132,583	134,542	136,792
7	117,000	122,125	127,583	130,042	132,250	134,417	136,208
8	116,750	122,333	127,750	129,250	130,583	132,792	134,833
9	114,292	116,708	118,958	120,792	121,958	123,417	125,042
10	116,875	128,208	132,708	136,208	139,500	142,375	144,958
11	117,000	128,750	133,958	137,292	140,292	143,333	145,458
12	117,333	129,417	135,208	137,958	140,000	142,333	144,625
13	116,500	127,375	132,667	134,958	136,083	137,583	139,083
14	116,125	118,792	122,042	125,208	127,875	130,542	133,125
15	116,292	122,208	127,250	130,750	133,167	135,167	137,917
16	116,458	122,708	127,875	131,208	134,042	136,125	138,292
17	116,167	120,583	124,458	127,542	129,583	131,708	133,792
18	115,500	120,542	125,083	126,708	128,583	130,708	132,458
▼19	114,958	116,583	118,583	120,375	121,583	123,208	124,792
20	116,875	128,208	132,708	136,208	139,500	142,375	144,958
21	117,000	128,750	133,958	137,292	140,292	143,333	145,458
22	117,333	129,417	135,208	137,958	140,000	142,333	144,625
23	116,500	127,375	132,667	134,958	136,083	137,583	139,083
24	115,958	116,708	118,625	120,958	123,500	125,875	128,458
25	115,083	116,333	117,333	118,667	119,917	121,542	123,083
26	111,167	115,667	116,875	118,000	119,875	120,042	121,208
27	105,750	108,875	115,167	116,333	116,833	117,167	117,125
28	115,917	116,333	117,042	117,833	118,583	119,458	120,750
29	115,750	115,833	116,500	117,542	118,500	119,875	121,458
30	115,917	116,625	118,625	121,042	123,458	126,000	128,500
31	114,792	125,250	129,625	130,958	131,875	132,667	133,167
32	114,792	125,250	129,625	130,958	131,875	132,667	133,167
33	114,292	116,583	119,167	120,958	121,958	123,000	123,875
34	111,917	112,583	113,958	115,333	116,417	117,708	118,667

Table 5.1-2a. 6 IN. DIA TANK TEST 8G #2 (Page 2 of 2)

35	108,333	108,542	109,292	110,125	110,917	111,958	112,750
36	114,792	125,250	129,625	130,958	131,875	132,667	133,167
37	116,250	116,708	117,708	119,040	120,250	121,708	123,333
38	116,292	117,167	118,333	120,292	121,833	123,917	126,042
39	116,458	117,667	119,542	122,083	124,417	126,958	129,458
40	116,667	118,458	120,708	123,500	125,917	128,667	131,083
41	116,958	119,167	121,500	123,417	125,500	128,958	131,250
42	117,042	119,125	121,250	123,667	124,125	128,958	131,375
43	117,292	120,000	121,958	124,250	126,625	129,708	131,708
44	117,208	119,458	121,750	124,000	126,750	129,875	132,833
45	117,083	120,083	122,208	123,958	126,875	129,250	131,792
46	117,167	119,417	121,750	125,000	127,792	130,458	132,667
47	117,625	120,625	123,208	125,792	123,792	131,708	133,833
48	118,083	119,375	121,083	123,917	126,333	129,292	131,833
49	116,333	117,208	119,458	121,792	124,583	128,583	129,042
50	116,750	116,917	119,083	121,417	123,833	126,583	129,833
51	116,458	116,938	119,365	121,552	123,979	126,146	128,073
52	116,958	117,458	119,729	121,979	124,250	126,500	128,438
53	115,958	116,417	119,000	121,125	123,708	125,792	127,708
54	117,958	118,500	120,458	122,833	124,792	127,208	129,167
55	117,875	118,083	120,417	122,583	124,917	127,500	129,333
56	117,958	118,500	120,458	122,833	124,792	127,208	129,167
57	117,875	118,083	120,417	122,563	124,917	127,500	129,333
58	117,042	117,094	119,432	121,651	123,740	125,990	127,745
59	117,625	117,250	119,500	121,750	123,500	125,833	127,417
60	118,917	118,875	120,667	122,500	124,125	126,667	128,792
61	115,833	115,208	116,542	118,125	119,583	121,875	123,333
62	115,958	115,833	116,375	118,542	119,458	121,042	122,542
63	117,083	116,750	117,625	119,333	120,833	122,875	124,292
64	118,167	118,167	118,708	120,458	121,958	123,125	124,125
65	115,542	115,125	115,625	116,542	117,667	119,333	120,708
66	115,792	115,458	115,667	116,208	117,167	119,125	119,750
67	116,792	116,292	115,667	117,208	118,292	119,833	120,708
68	115,604	115,292	115,583	116,083	116,813	118,521	119,042
69	115,292	115,042	115,208	115,917	116,125	117,542	118,375
70	115,417	115,125	115,500	115,917	116,458	117,917	118,333
71	116,000	115,750	116,292	116,750	117,250	118,458	119,292
72	116,625	117,063	117,917	118,625	119,167	120,250	121,625
73	114,458	115,458	117,167	116,708	118,000	119,333	119,833
74	106,125	106,208	107,000	107,917	109,667	110,083	111,000
75	90,917	90,667	90,958	91,042	91,083	91,542	91,500
76	103,333	103,083	103,292	103,708	104,083	104,750	105,033
77	87,667	87,292	87,417	87,333	87,208	87,250	[illegible],083

Table 5.1-2b. 6 IN. DIA TANK TEST 8G #12S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.333	1.000	1.667	2.000
TAU	0.000	.167	.500	.833	1.000
1	117.708	121.042	128.000	133.458	135.958
2	117.958	124.708	134.875	140.875	143.292
3	118.208	123.792	133.417	139.458	142.042
4	118.375	124.333	134.125	139.583	141.417
5	117.667	122.833	131.458	136.375	138.458
6	117.750	123.208	131.042	135.917	137.583
7	117.875	123.500	130.771	134.938	136.688
8	118.000	123.792	130.500	133.958	135.792
9	116.875	119.125	123.000	125.708	127.125
10	117.833	129.458	137.792	143.958	146.583
11	117.958	130.042	138.417	144.458	146.542
12	118.250	130.667	138.208	143.042	145.042
13	117.458	128.917	135.667	138.500	139.750
14	116.708	120.000	125.917	131.500	133.958
15	117.167	123.417	131.417	136.250	138.625
16	117.708	123.917	132.333	137.333	139.500
17	117.146	122.813	129.958	134.458	136.354
18	116.583	121.708	127.583	131.583	133.208
19	116.000	117.792	121.083	124.083	125.583
20	117.833	129.458	137.792	143.958	146.583
21	117.958	130.042	138.417	144.458	146.542
22	118.250	130.667	138.208	143.042	145.042
23	117.458	128.917	135.667	138.500	139.750
24	116.917	118.250	123.000	127.833	129.792
25	116.708	117.875	121.958	127.042	129.167
26	115.083	117.542	222.375	170.333	146.458
27	116.375	117.875	122.083	127.042	129.208
28	117.083	118.000	120.958	125.542	127.917
29	116.750	117.125	120.042	124.458	126.583
30	116.750	118.208	122.875	127.708	129.750
31	117.458	127.931	132.833	134.153	134.958
32	118.208	128.792	133.917	135.042	135.875
33	115.917	118.375	122.125	124.125	124.750

Table 5.1-2b. 6 IN. DIA TANK TEST 8G #12S (Page 2 of 2)

34	113.167	113.792	116.125	118.417	119.333
35	109.792	110.083	111.292	112.833	113.458
36	117.083	127.500	132.292	133.708	134.500
37	117.042	118.458	122.292	127.250	129.458
38	116.917	118.583	123.042	127.875	130.083
39	117.167	118.875	123.750	128.500	130.417
40	117.458	119.500	124.042	128.792	130.667
41	117.708	120.500	124.625	129.417	131.958
42	117.958	120.042	124.417	129.625	132.333
43	118.167	120.917	124.875	130.167	132.125
44	118.083	120.458	125.083	130.542	132.917
45	118.125	121.167	125.208	130.000	132.250
46	117.917	120.417	125.792	131.208	133.208
47	118.333	121.750	127.875	132.292	134.667
48	118.833	120.083	125.083	130.292	132.625
49	117.375	118.792	123.083	127.750	130.208
50	117.750	118.542	122.958	127.333	130.125
51	117.333	119.542	122.625	126.292	128.708
52	118.104	119.625	123.208	127.188	129.354
53	117.292	118.250	122.875	127.125	129.083
54	118.875	119.708	123.792	128.083	130.000
55	118.625	119.542	123.917	128.042	130.542
56	118.875	119.708	123.792	128.083	130.000
57	118.708	119.597	123.875	128.056	130.361
58	117.333	117.750	122.583	126.667	128.292
59	118.333	118.792	122.667	126.958	128.667
60	119.875	119.792	123.292	127.292	129.875
61	116.917	116.958	119.583	122.625	124.667
62	117.333	117.125	119.625	122.125	124.292
63	117.958	118.125	120.583	123.333	125.542
64	119.083	119.042	121.042	124.125	125.833
65	116.875	116.875	118.208	120.708	122.208
66	116.917	116.917	117.875	120.333	121.792
67	117.667	117.833	118.667	121.000	122.458
68	118.625	118.750	119.083	120.583	122.000
69	116.667	116.708	117.167	119.000	120.333
70	116.792	117.000	117.500	119.250	120.250
71	117.333	117.333	118.125	119.417	120.708
72	118.000	118.708	119.917	121.667	122.833
73	115.917	116.542	118.292	119.917	121.083
74	109.333	109.958	112.042	114.375	115.917
75	95.708	96.167	97.125	97.875	98.625
76	106.083	106.042	106.500	107.458	108.042
77	91.958	91.833	91.792	91.333	91.292

Table 5.1-2c. 12 IN. DIA TANK TEST 1G #30 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	2,000	4,000	6,000	8,000
TAU	0,000	,250	,500	,750	1,000
1	117,250	123,917	127,667	131,042	134,000
~~2~~	~~117,208~~	~~124,167~~	~~130,292~~	~~133,750~~	~~136,792~~
3	117,542	127,333	131,500	134,542	137,583
4	117,583	127,042	130,250	133,292	135,917
5	117,542	127,083	131,083	133,958	134,458
6	117,458	125,583	128,583	131,375	133,958
7	117,542	125,417	128,000	130,542	133,167
V 8	117,625	125,708	128,292	130,792	133,125
9	117,167	121,458	124,375	127,167	129,542
10	117,375	135,000	138,750	142,083	145,292
11	117,542	134,917	138,250	141,375	144,125
12	117,667	133,417	135,125	139,083	141,792
13	117,542	134,375	137,208	139,208	141,375
~~14~~	~~117,000~~	~~123,542~~	~~127,083~~	~~130,625~~	~~133,500~~
15	117,375	131,292	135,417	139,083	141,958
16	117,583	130,500	134,208	137,500	139,958
17	117,250	130,667	133,792	136,708	139,333
18	117,292	129,333	131,583	134,500	136,750
19	116,917	121,042	123,458	126,292	128,625
~~20~~	~~117,792~~	~~135,375~~	~~138,667~~	~~142,208~~	~~145,125~~
21	117,667	135,167	138,250	141,542	144,375
22	117,750	133,375	136,792	139,708	142,292
23	117,750	133,792	136,333	138,750	141,208
24	116,583	119,000	122,167	125,375	128,333
25	116,375	118,333	120,750	123,375	125,792
~~26~~	~~116,208~~	~~118,208~~	~~120,583~~	~~123,125~~	~~125,500~~
27	116,292	118,292	120,500	122,875	125,125
28	117,458	118,083	119,667	121,750	123,917
29	117,042	117,958	120,000	122,417	124,708
30	116,708	118,917	122,083	125,292	128,250
31	118,292	133,708	136,292	138,542	140,917
~~32~~	~~118,042~~	~~132,167~~	~~134,208~~	~~136,542~~	~~139,000~~
33	115,833	120,958	122,708	124,583	126,458
34	115,500	115,208	115,458	115,875	116,333
35	115,292	114,500	114,000	113,792	113,458

Table 5. 1-2c. 12 IN. DIA TANK TEST 1G #30 (Page 2 of 2)

36	118,667	133,958	136,625	138,667	141,083
37	118,042	118,708	121,083	123,667	126,208
~~38~~	~~117,750~~	~~118,958~~	~~121,750~~	~~124,792~~	~~127,625~~
39	117,417	119,417	122,542	125,875	128,833
40	117,125	120,000	123,292	126,417	129,667
~~41~~	~~117,667~~	~~120,000~~	~~122,750~~	~~126,000~~	~~128,958~~
42	117,667	120,167	123,250	126,625	129,583
43	117,792	120,417	123,542	126,750	129,708
~~44~~	~~117,917~~	~~120,250~~	~~123,292~~	~~126,417~~	~~129,333~~
45	117,708	119,958	122,667	125,875	128,833
46	117,625	121,000	124,042	127,417	130,333
~~47~~	~~117,792~~	~~120,458~~	~~123,750~~	~~127,208~~	~~129,958~~
48	118,000	120,542	123,542	126,792	129,833
49	118,792	120,417	123,083	126,375	129,208
~~50~~	~~117,792~~	~~119,833~~	~~122,583~~	~~125,917~~	~~128,792~~
51	117,625	119,000	121,042	123,833	126,667
52	117,500	119,625	122,083	125,083	128,208
~~53~~	~~117,333~~	~~119,833~~	~~122,792~~	~~125,708~~	~~128,667~~
54	117,708	119,625	122,542	125,417	128,333
55	117,458	119,583	122,417	125,375	128,333
~~56~~	~~117,625~~	~~119,500~~	~~122,083~~	~~125,083~~	~~128,250~~
57	117,375	119,542	122,250	125,458	128,542
58	117,667	119,292	121,917	124,833	127,792
~~59~~	~~117,417~~	~~118,792~~	~~121,417~~	~~124,417~~	~~127,333~~
60	117,292	118,667	121,333	124,333	127,042
61	117,417	118,583	120,958	123,250	125,958
~~62~~	~~117,542~~	~~118,583~~	~~120,833~~	~~123,625~~	~~126,250~~
63	117,292	118,417	120,542	123,250	125,792
64	117,208	118,125	120,250	122,625	125,333
~~65~~	~~117,250~~	~~118,250~~	~~120,375~~	~~122,708~~	~~125,375~~
66	117,208	117,875	119,792	122,042	124,458
67	117,208	117,875	119,750	122,042	124,458
~~68~~	~~117,208~~	~~117,708~~	~~119,375~~	~~121,583~~	~~124,000~~
69	117,292	117,750	119,458	121,583	124,000
70	116,417	117,625	119,167	121,458	123,667
~~71~~	~~117,167~~	~~117,583~~	~~119,167~~	~~121,458~~	~~123,667~~
72	117,208	117,750	119,708	121,417	123,750
73	117,167	117,792	119,417	121,417	123,708
▼74	96,875	96,792	96,833	96,958	97,292
75	106,500	106,542	107,000	107,708	108,708
76	87,917	87,958	87,875	88,000	88,042
~~77~~	~~98,583~~	~~98,625~~	~~98,708~~	~~98,958~~	~~99,333~~

Table 5.1-2d. 12 IN. DIA TANK TEST 1G #25 (Page 1 of 2)

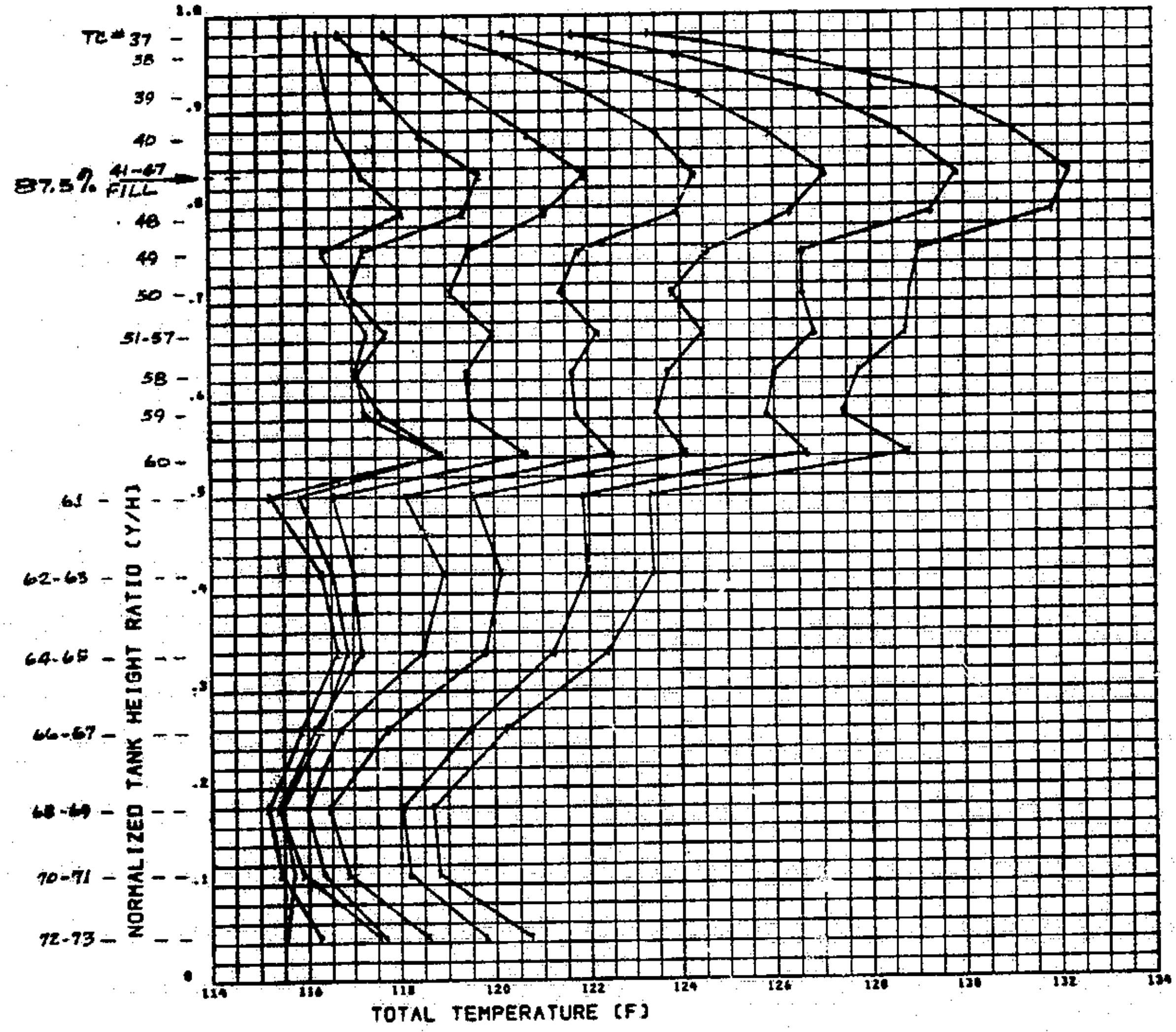
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	2.000	4.000	6.000	8.000
TAU	0.000	.250	.500	.750	1.000
1	116.958	123.583	127.542	130.625	133.542
2	116.875	125.958	130.000	133.292	136.375
3	117.292	127.333	131.500	134.542	137.417
4	117.458	126.625	130.417	133.375	136.250
5	117.375	127.625	131.333	134.042	136.750
6	117.333	125.958	128.625	131.333	133.875
7	117.417	125.500	128.042	130.542	133.083
8	117.417	125.708	128.333	130.292	133.125
9	116.958	121.500	124.292	126.958	129.458
10	117.292	134.958	138.542	141.958	144.875
11	117.375	134.833	138.458	141.125	144.000
12	117.417	133.417	136.375	138.875	141.708
13	117.208	135.208	136.917	139.583	141.542
14	116.625	123.250	126.792	130.125	133.083
15	117.167	131.500	134.917	138.667	141.417
16	117.333	130.542	134.625	137.250	140.083
17	117.167	129.917	133.917	136.625	138.958
18	117.042	129.542	131.833	134.167	136.458
19	116.583	120.917	123.458	125.875	128.333
20	117.833	135.250	138.667	141.583	144.833
21	117.583	135.000	138.583	141.292	144.333
22	117.375	133.583	136.625	139.417	141.708
23	117.417	134.292	136.458	138.792	141.167
24	116.625	118.792	122.000	125.167	128.125
25	116.208	118.000	120.500	123.125	126.042
26	116.042	117.875	120.333	123.083	125.792
27	115.917	117.917	120.292	122.833	125.667
28	117.083	117.875	119.500	121.583	124.042
29	117.083	117.750	119.792	122.250	124.917
30	116.458	118.625	121.833	125.042	128.000
31	117.875	133.375	135.917	138.167	140.375
32	117.583	131.958	133.958	136.167	138.542
33	115.208	120.708	122.542	124.292	126.208
34	114.958	114.833	115.250	115.708	116.250

Table 5.1-2d. 12 IN. DIA TANK TEST 1G #25 (Page 2 of 2)

35	114.875	114.167	113.667	113.292	112.958
36	118.375	133.875	136.125	138.292	140.583
37	117.458	118.375	120.833	123.625	126.333
38	117.458	118.708	121.667	124.667	127.583
39	117.125	119.208	122.500	125.542	128.583
40	117.125	119.875	123.208	126.250	129.250
41	117.375	119.917	122.958	125.708	128.708
42	117.458	120.208	123.375	126.500	129.458
43	117.458	120.292	123.500	126.542	129.542
44	117.667	120.292	122.917	126.208	129.167
45	117.417	120.375	122.833	125.833	128.708
46	117.375	121.125	124.375	127.250	130.208
47	117.542	120.542	123.542	126.750	129.833
48	117.792	120.417	123.583	126.542	129.583
49	117.667	120.083	123.083	125.896	128.938
50	117.542	119.750	122.583	125.250	128.292
51	117.500	118.958	121.042	123.750	126.583
52	117.500	119.417	121.917	125.083	128.125
53	117.250	119.667	122.708	125.583	128.833
54	117.625	119.625	122.375	125.458	128.208
55	117.375	119.333	122.458	125.250	128.042
56	117.500	119.417	121.917	124.958	128.000
57	117.250	119.375	122.542	125.375	128.458
58	117.542	119.042	121.750	124.750	127.792
59	117.250	118.708	121.375	124.417	127.458
60	117.167	118.500	121.375	124.042	127.042
61	117.333	118.458	120.750	123.083	125.833
62	117.458	118.542	120.625	123.333	126.083
63	117.167	118.208	120.333	123.042	125.792
64	117.083	118.000	120.125	122.458	125.125
65	117.208	118.000	120.125	122.542	125.167
66	117.097	117.736	119.611	121.806	124.347
67	117.125	117.708	119.542	121.667	124.250
68	117.083	117.500	119.167	121.292	123.667
69	117.167	117.542	119.333	121.375	123.792
70	117.083	117.500	119.167	121.250	123.500
71	117.042	117.458	119.083	121.083	123.417
72	117.125	117.542	119.250	121.375	123.417
73	117.083	117.625	119.042	121.083	123.333
74	95.000	94.875	94.833	94.958	95.125
75	105.333	105.292	105.708	106.500	107.417
76	89.417	89.375	89.250	89.292	89.167
77	100.500	100.333	100.333	100.500	100.792

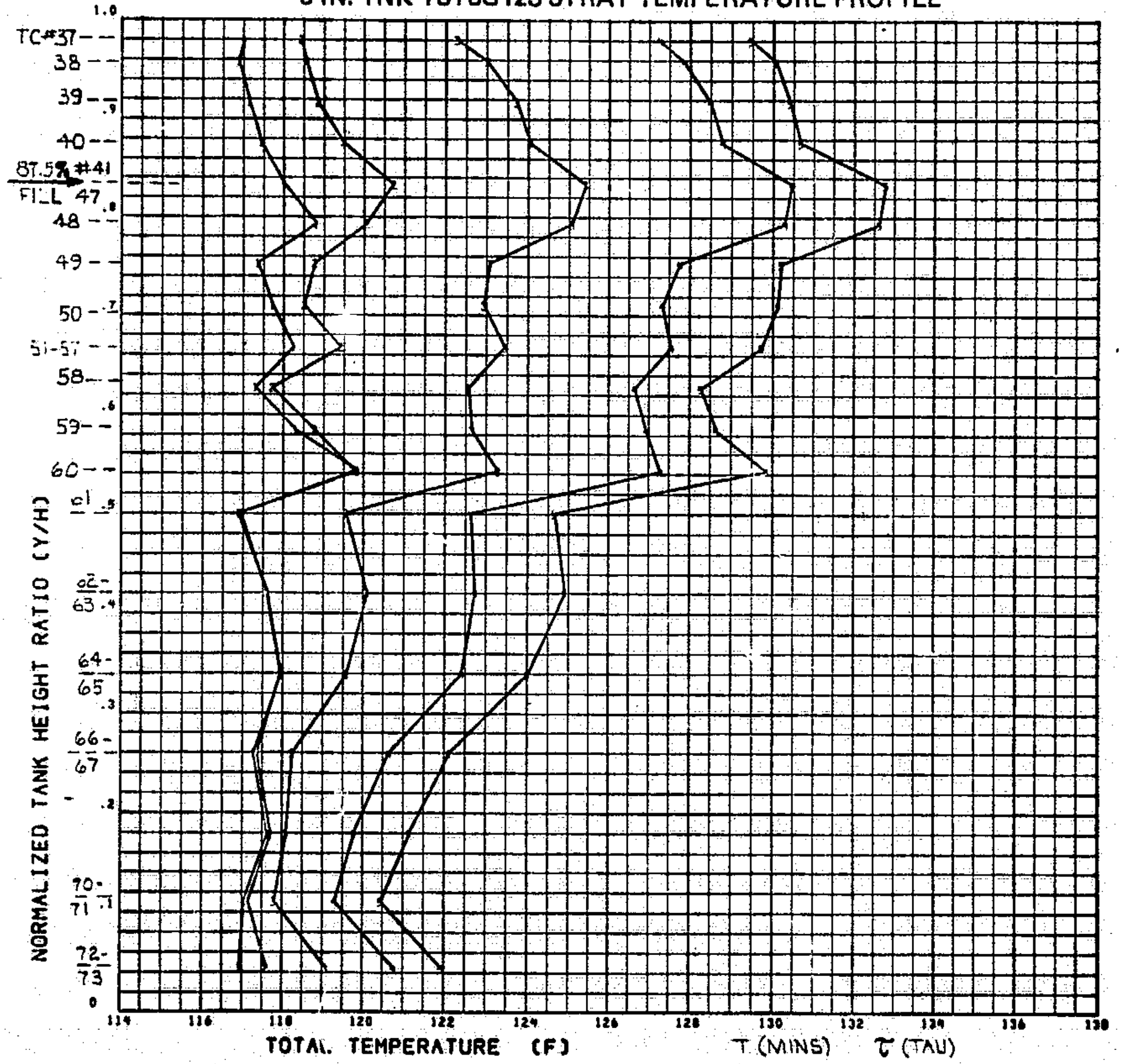
FIGURE 5.1-1a
6 IN. TNK TEST 8GΣ2 – STRAT TEMPERATURE PROFILE



	T(min)	TAU
1	0.	0.
2	.33	.165
3	.66	.33
4	1.00	.5
5	1.33	.665
6	1.66	.83
7	2.00	1.00

q''_H = 1000 BTU/hr ft² LIQ HT'G ONLY

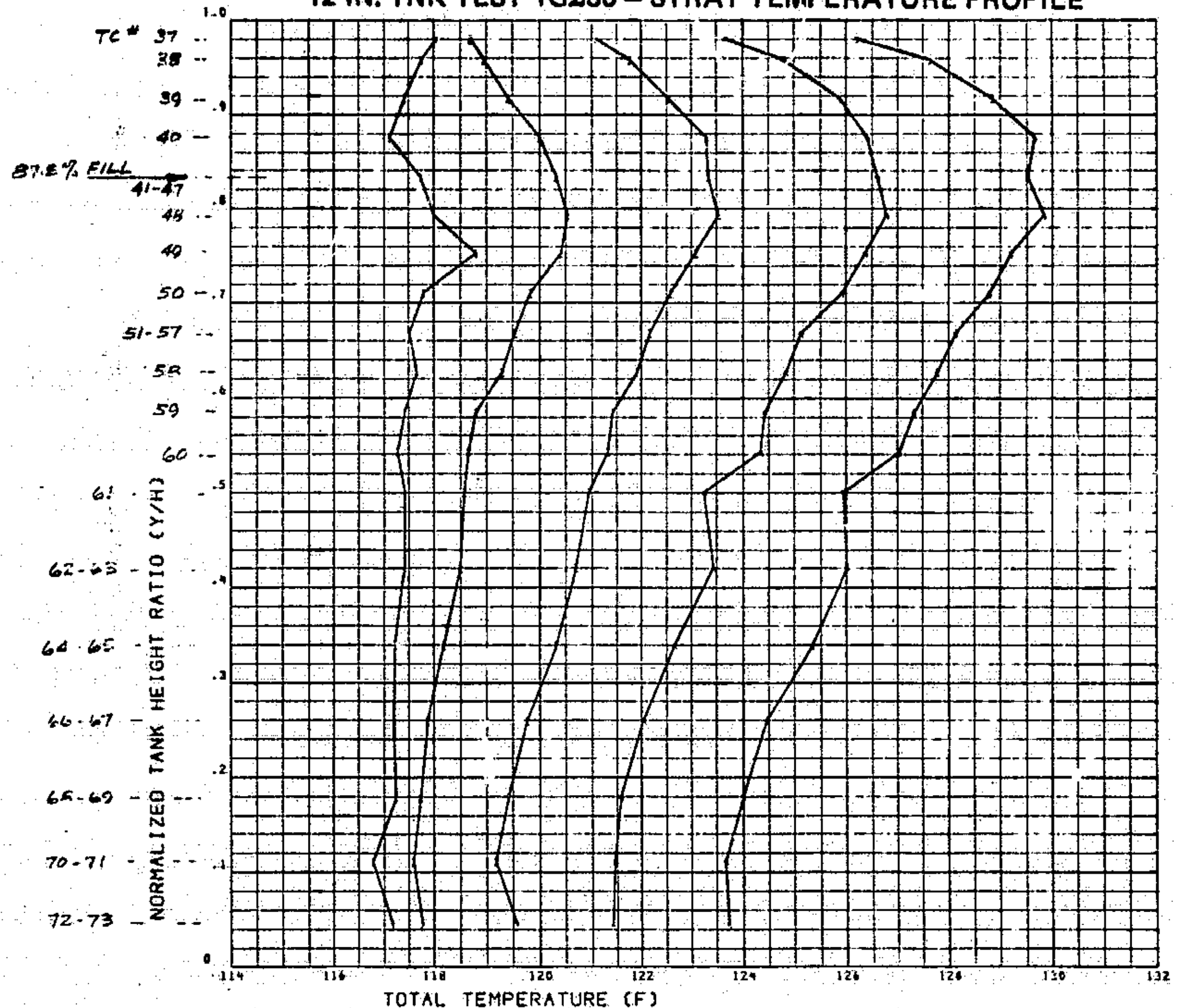
FIGURE 5.1-1b
6 IN. TNK TST8G12S STRAT TEMPERATURE PROFILE



	T (MINS)	τ (TAU)
1	0	0
2	.333	.167
3	1.000	.50
4	1.667	.83
5	2.000	1.000

q''_H = 1000 BTU/HR FT^2 LIQ HT'G ONLY

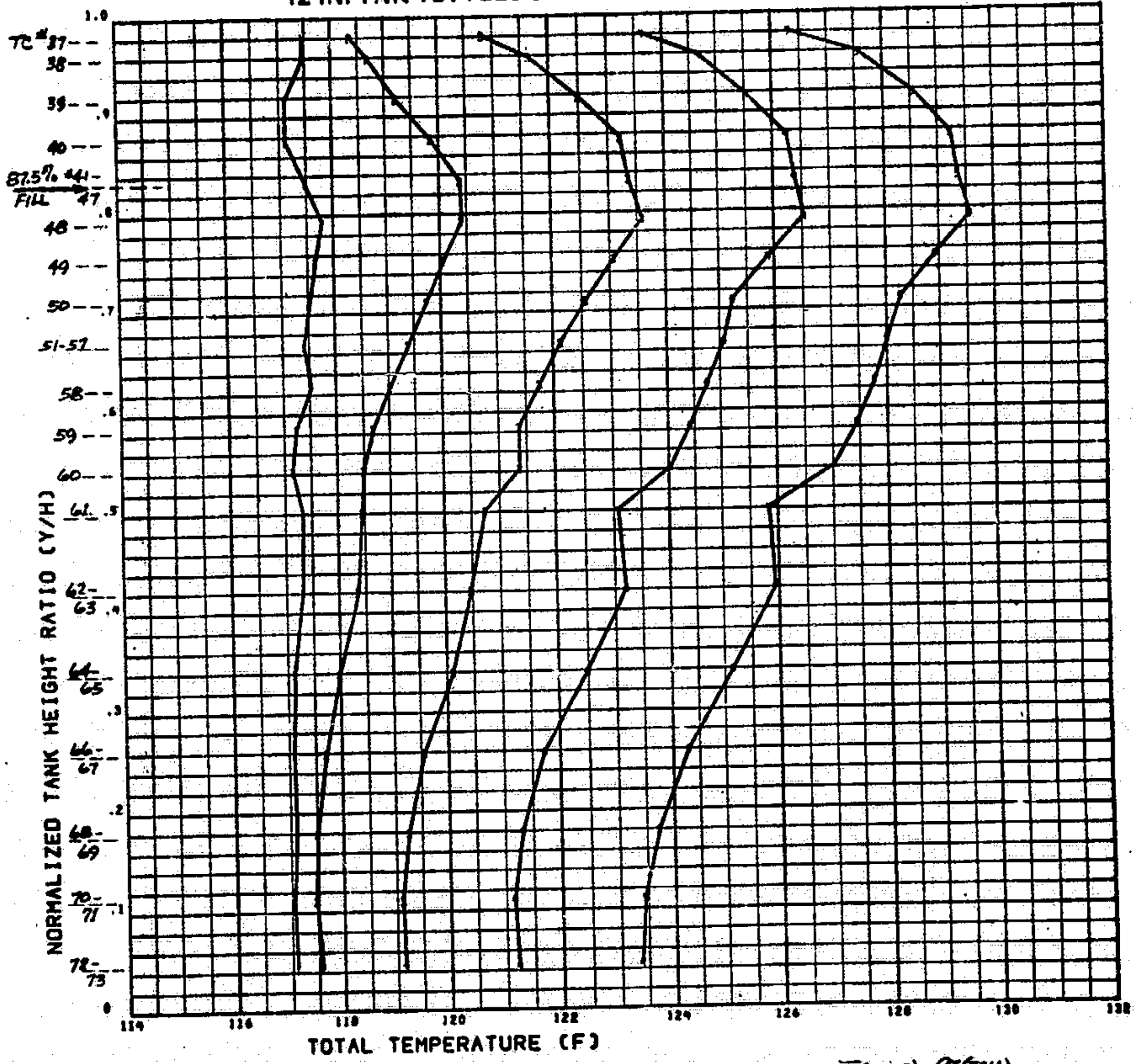
FIGURE 5.1-1c
12 IN. TNK TEST 1GΣ30 – STRAT TEMPERATURE PROFILE



q''_H = 500 BTU/hr ft^2 LIQ HT'G ONLY

	T (mins)	τ/τau
1	0.	0.
2	2.	.25
3	4.	.5
4	6.	.75
5	8.	1.0

FIGURE 5.1-1d
12 IN. TNK TST1G25 STRAT TEMPERATURE PROFILE



$\dfrac{q''}{\dot{Q}_H}$ = 500 BTU/hr ft² LIQ HT'G ONLY

	T (mins)	τ (TAU)
1	0.	0.
2	2.	.25
3	4.	.5
4	6.	.75
5	8.	1.0

FIGURE 5.1-2a
6 IN. TNK TEST 8GΣ2 – STRAT DEL – TEMP PROFILE

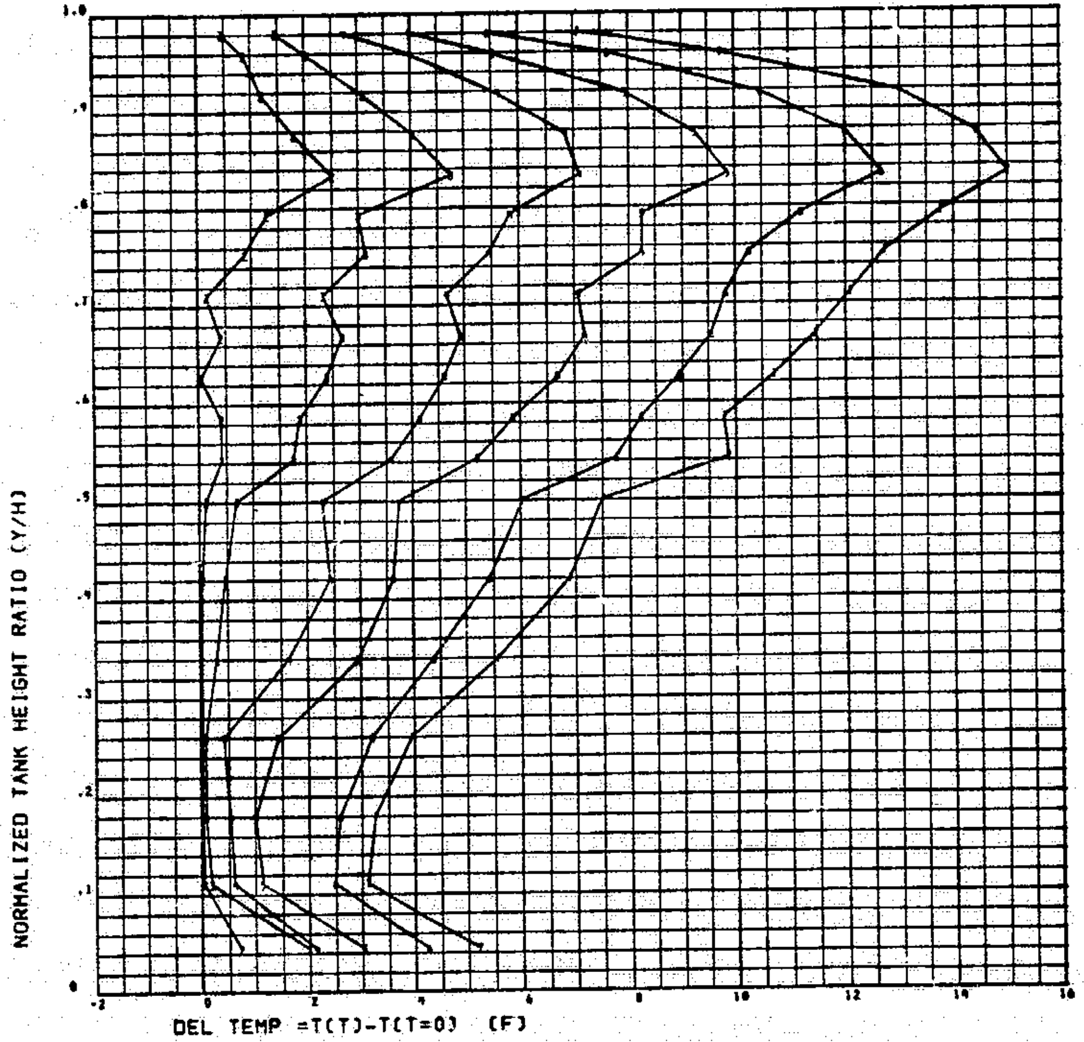


FIGURE 5.1-2b

6 IN. TNK TST8G12S STRAT DEL – TEMP PROFILE

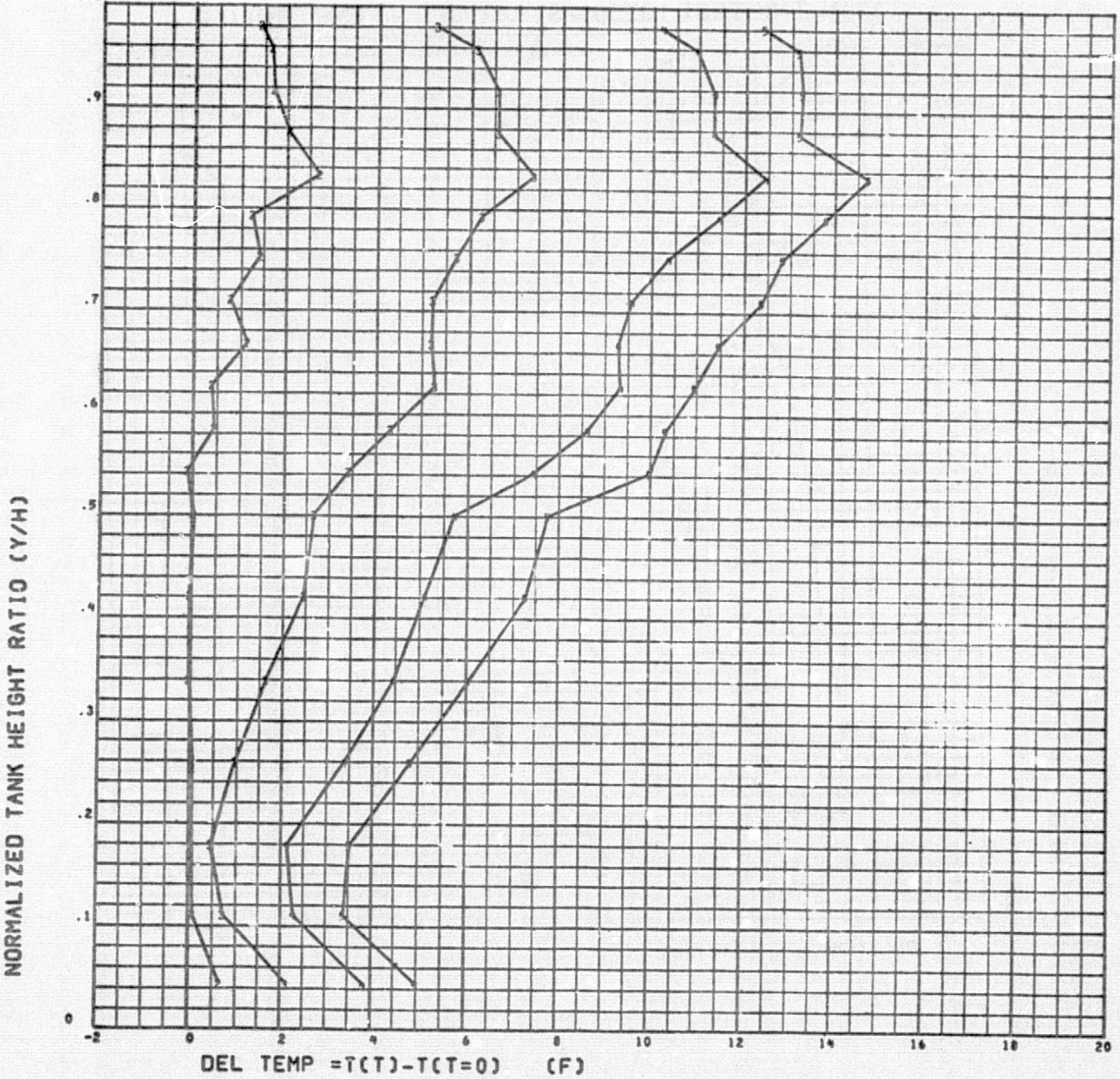


FIGURE 5.1-2c

12 IN. TNK TEST 1GΣ30 – STRAT DEL – TEMP PROFILE

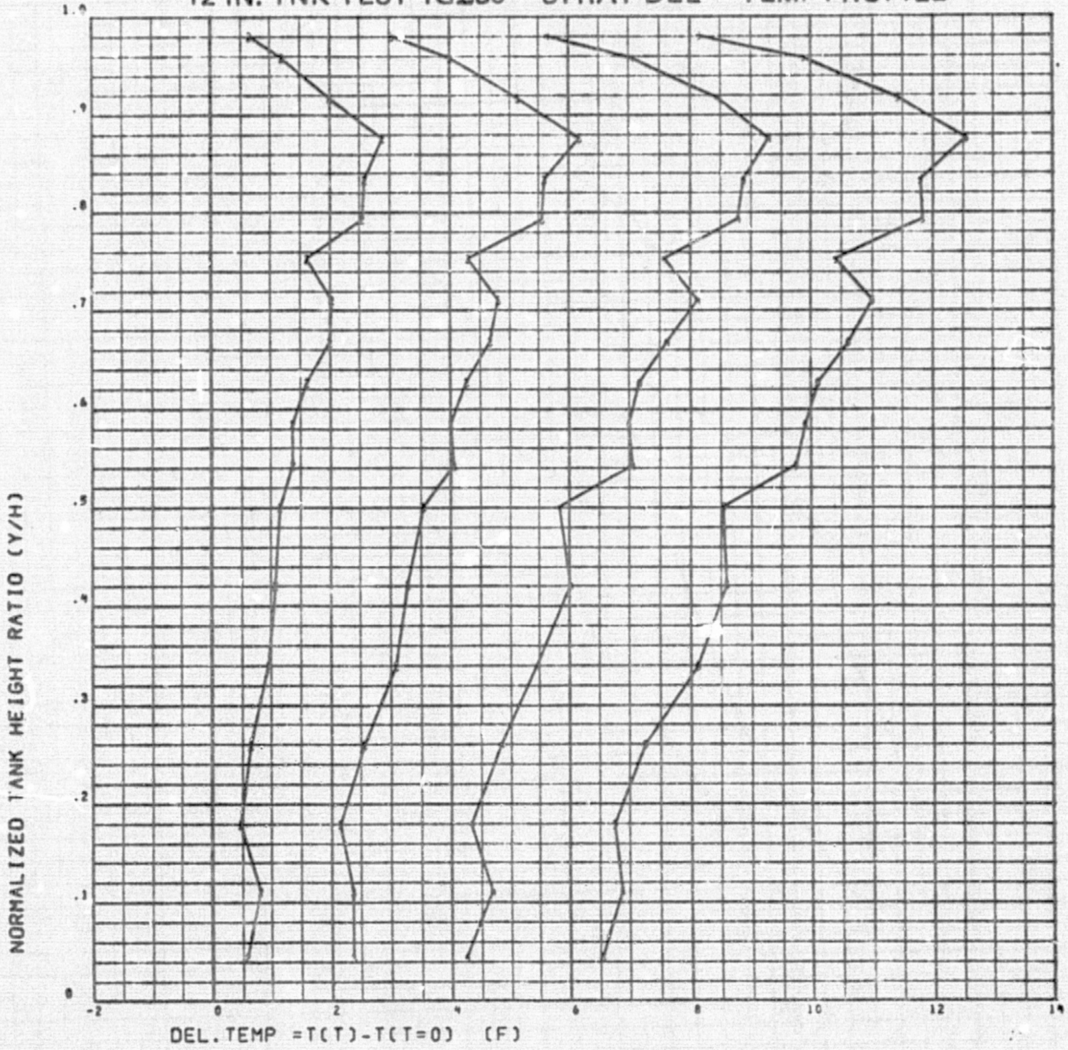


FIGURE 5.I-2d
12 IN. TNK TST1G25 STRAT DEL – TEMP PROFILE

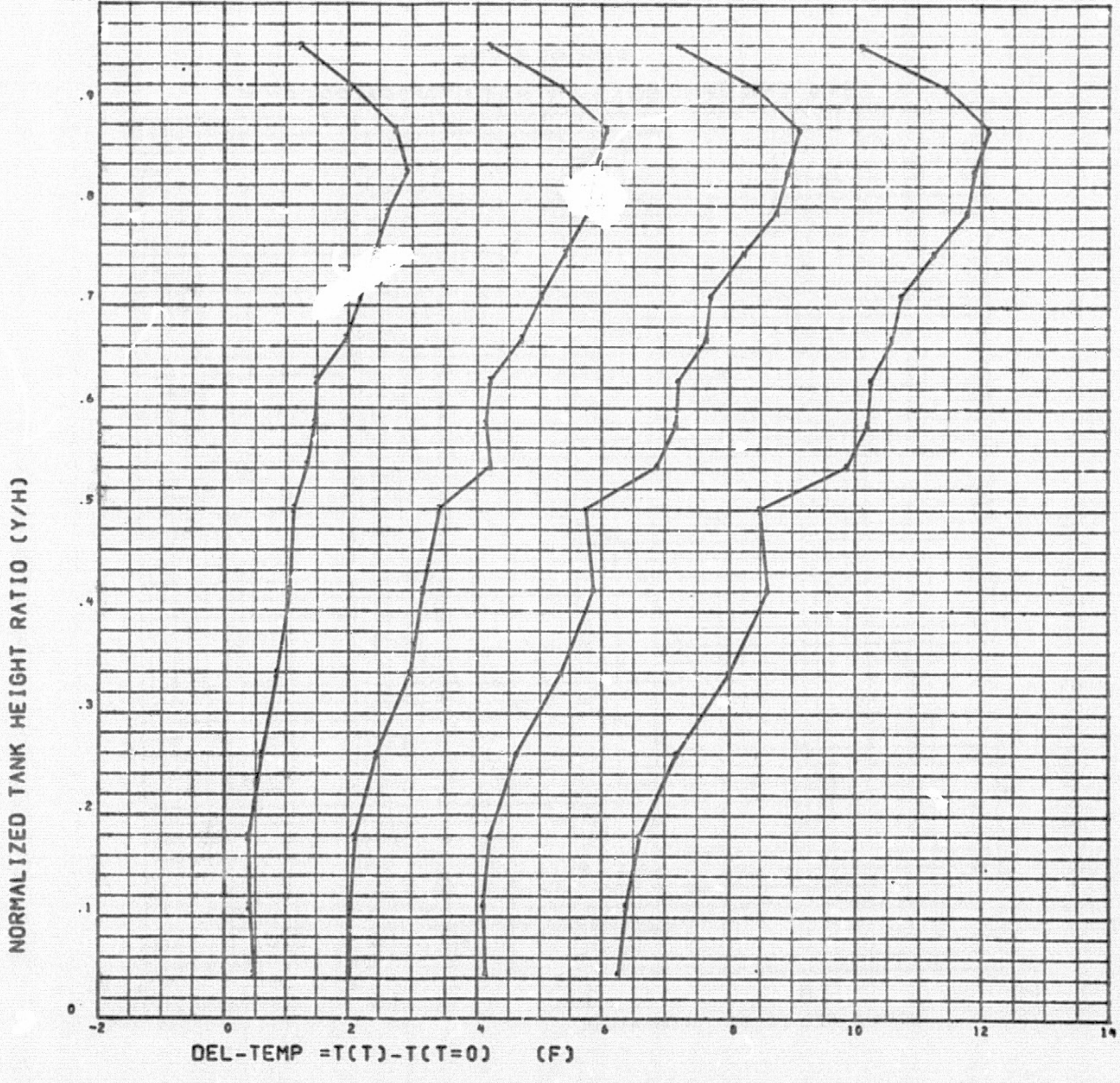


FIGURE 5.1-3a

6 IN. TNK TEST 8GΣ2 – STRAT DTNORM PROFILE

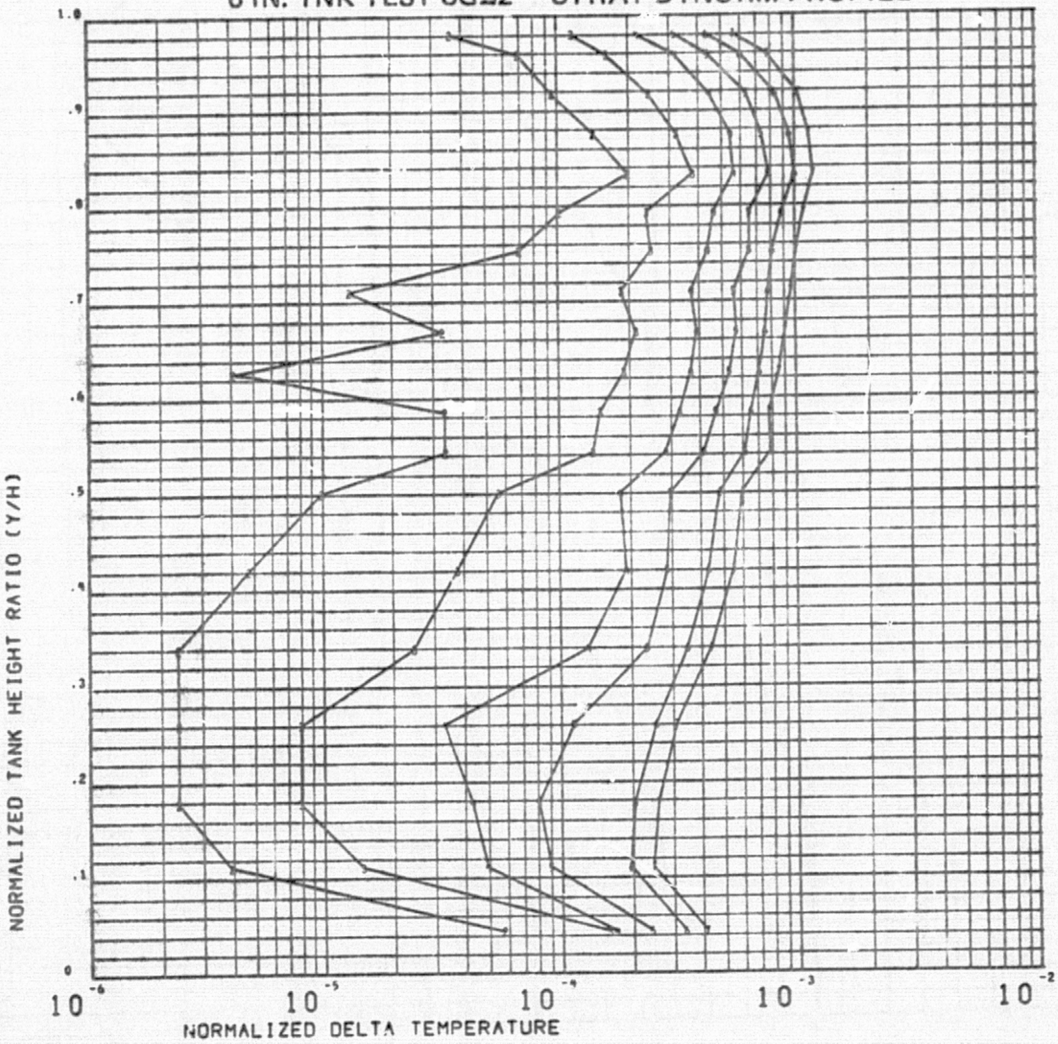


FIGURE 5.I-3b
6 IN. TNK TST8G12S STRAT DTNORM PROFILE

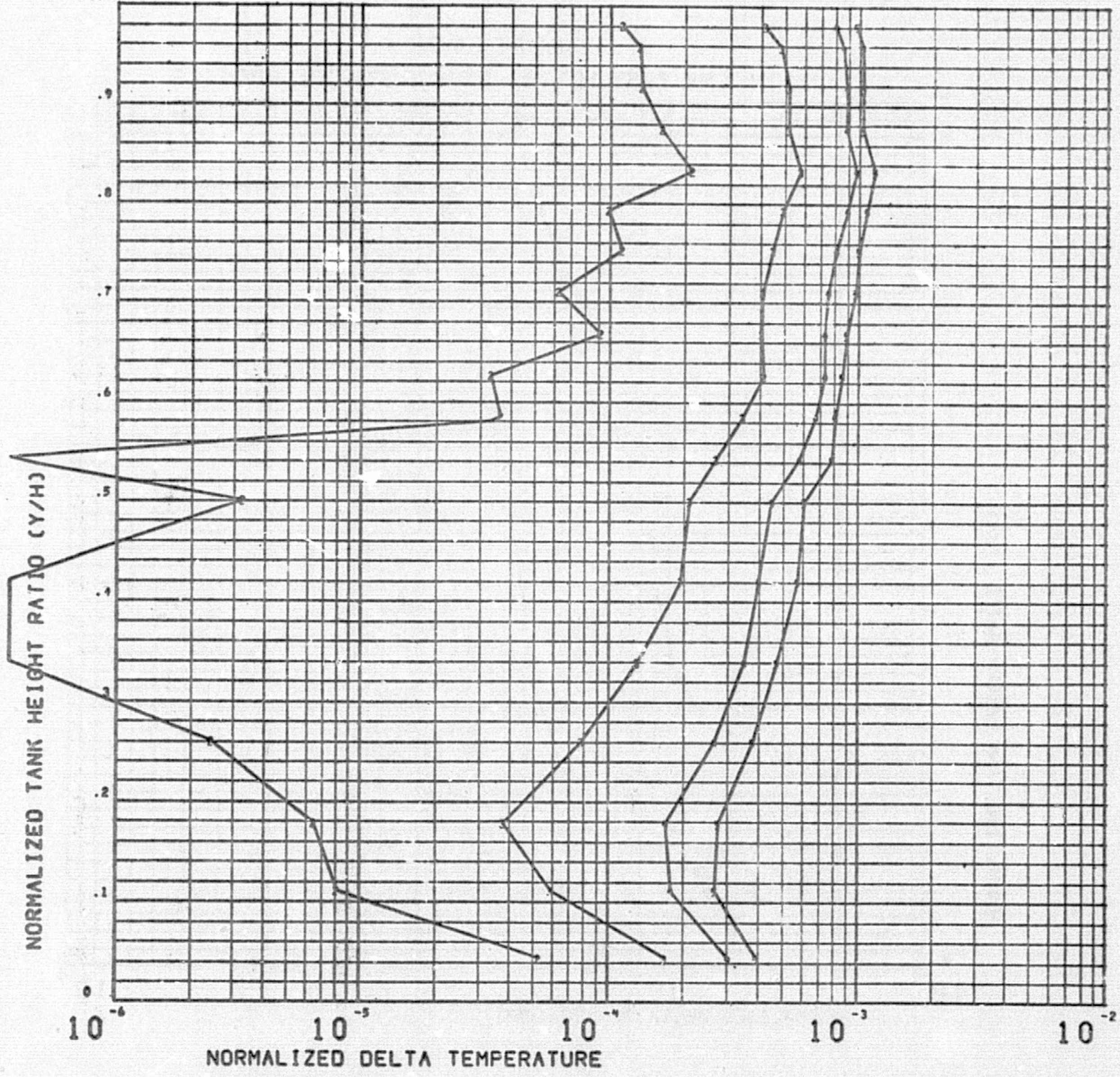


FIGURE 5.1-3c
12 IN. TNK TEST 1GΣ30 – STRAT DTNORM PROFILE

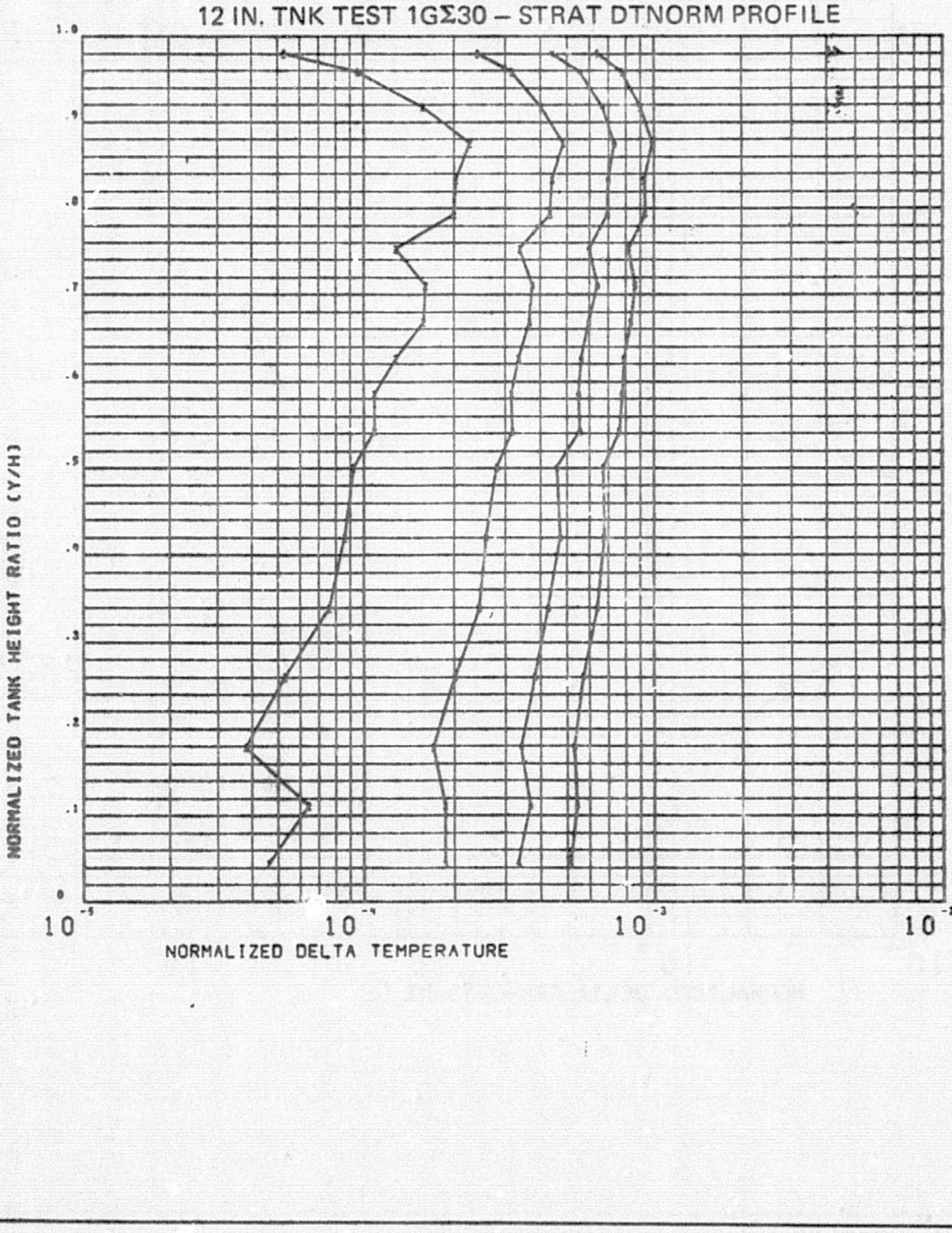


FIGURE 5.1-3d
12 IN. TNK TST1G25 STRAT DTNORM PROFILE

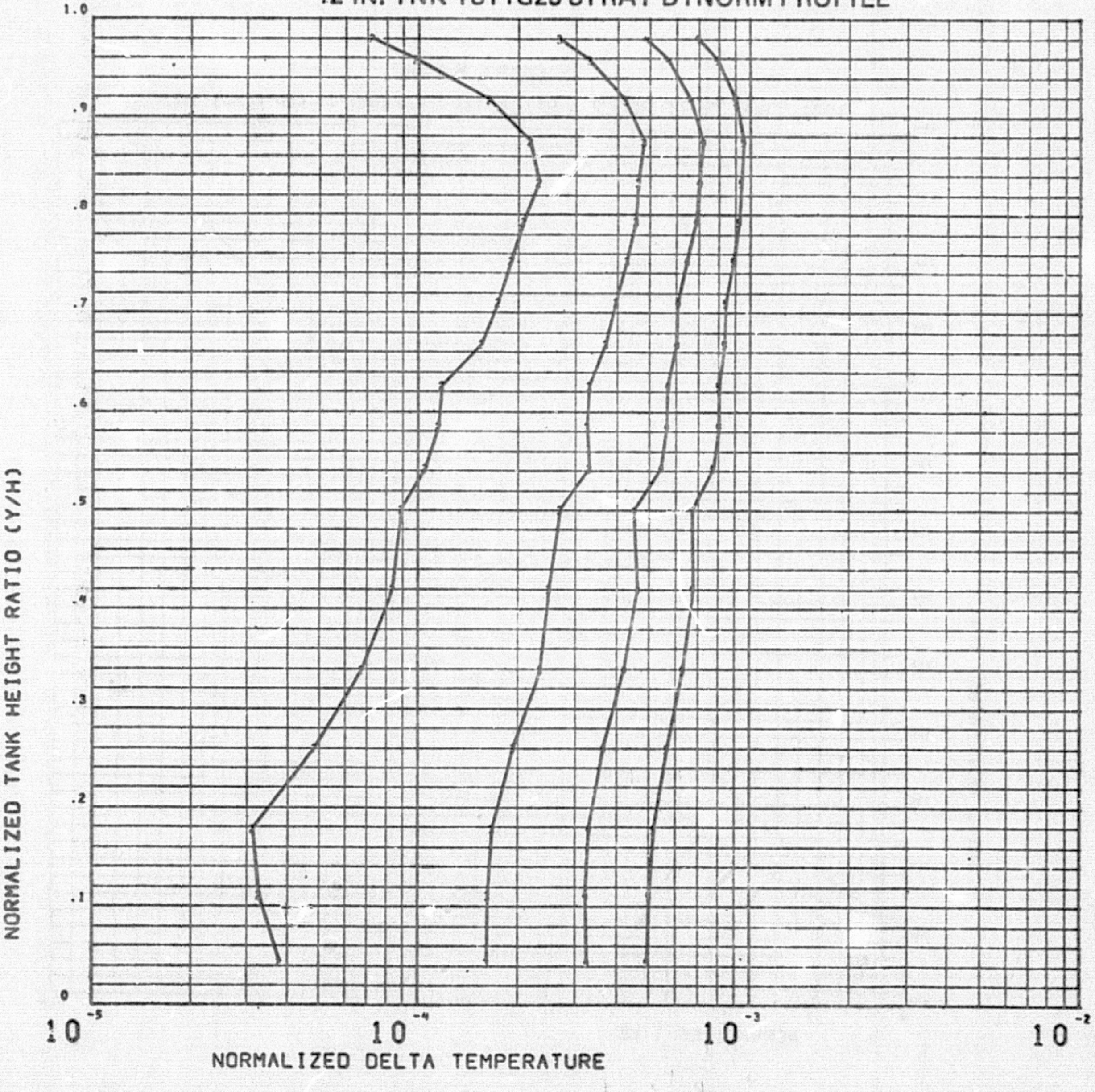


FIGURE 5.1-4a

6 IN. TNK TEST 8GΣ2 – BULK ULGE γ LIQ TEMP HISTORIES

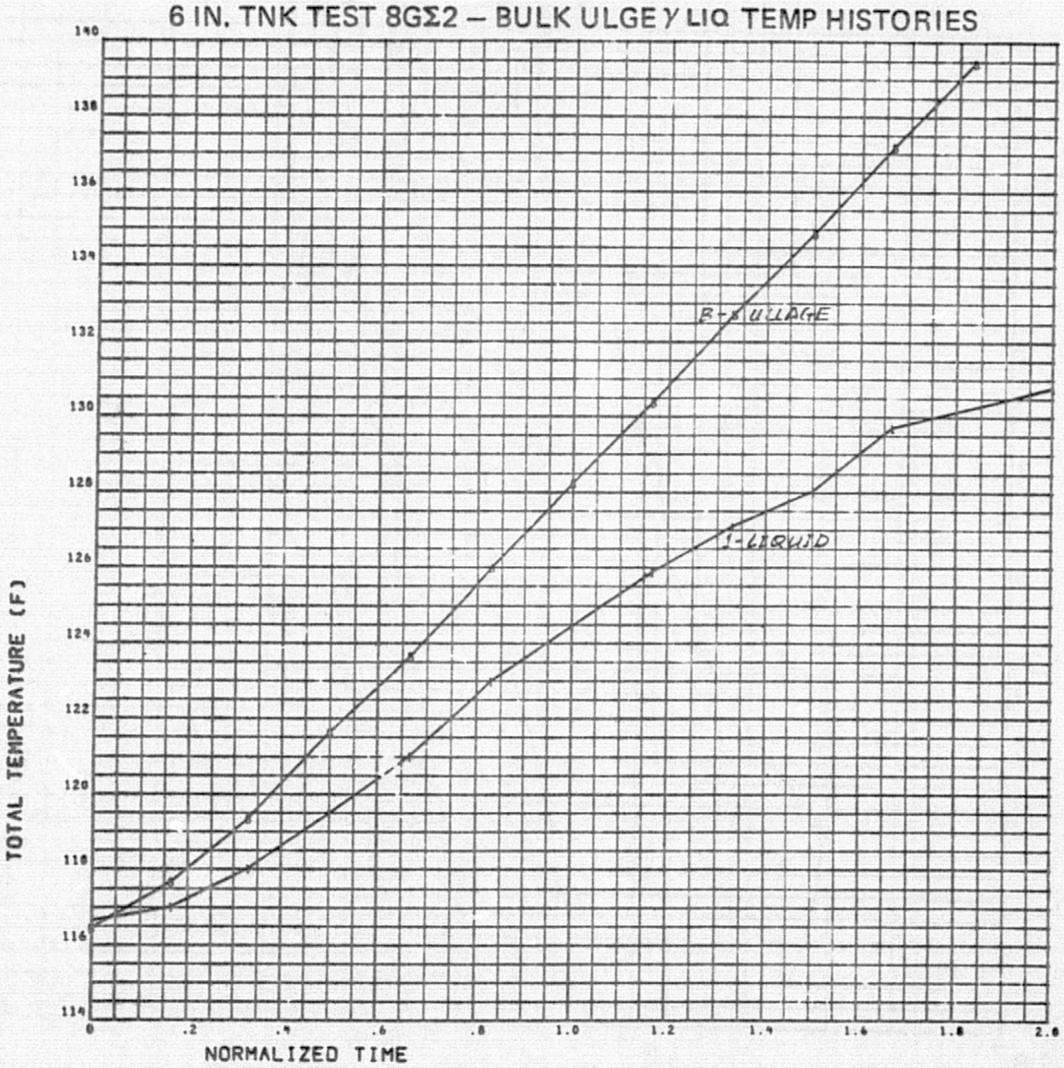
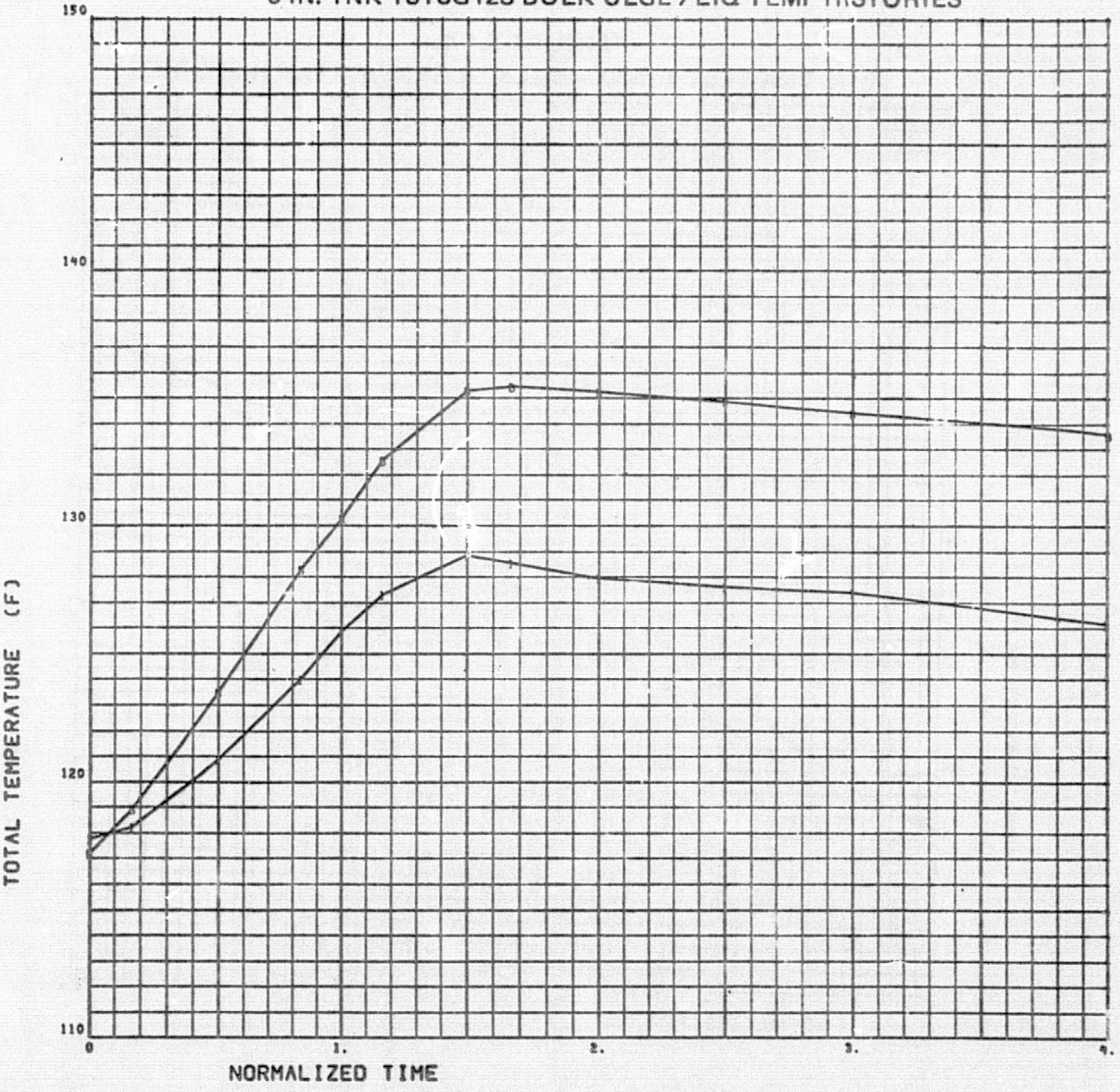


FIGURE 5.1-4b
6 IN. TNK TST8G12S BULK ULGE/LIQ TEMP HISTORIES



B - ULLAGE
I - LIQUID

FIGURE 5.1-4c

12 IN. TNK TEST 1GΣ30 – BULK ULGE/LIQ TEMP HISTORIES

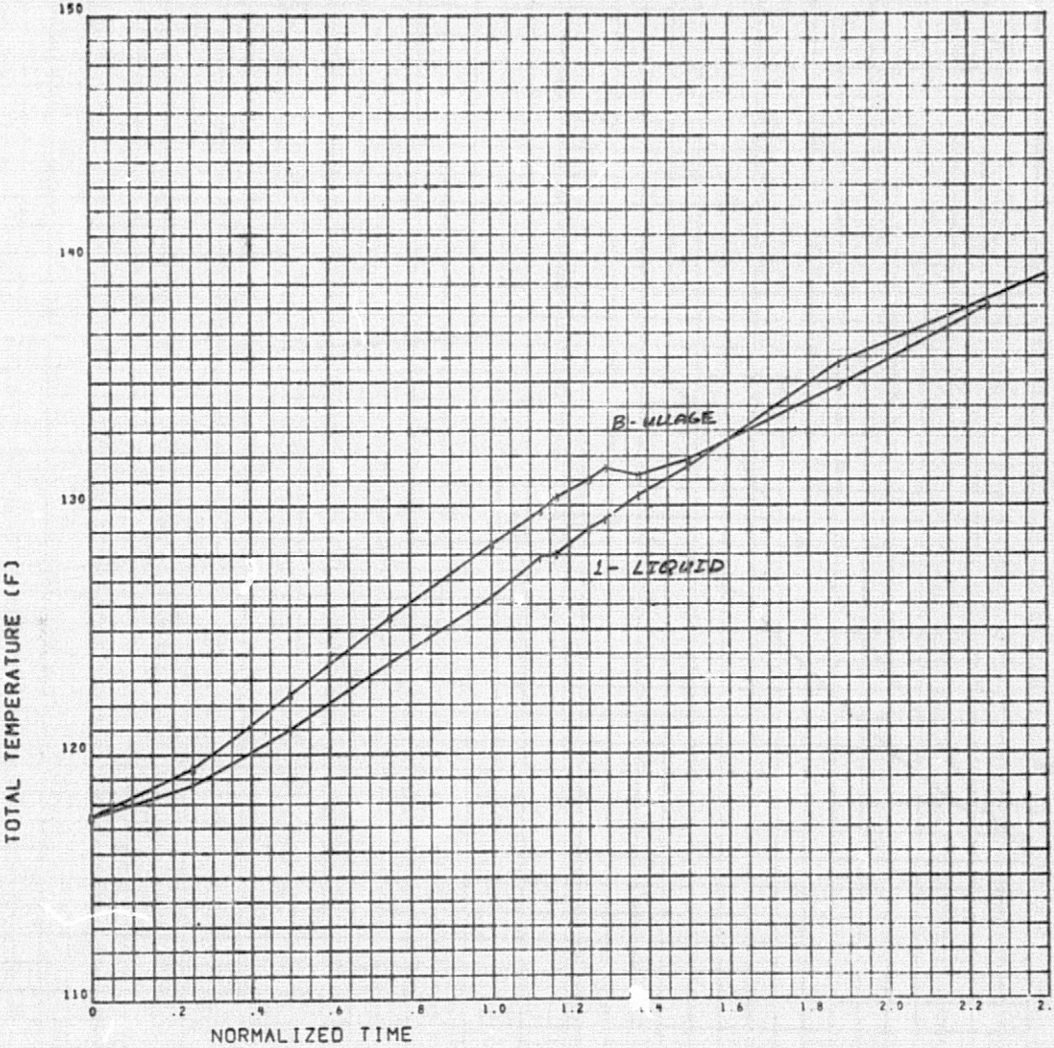
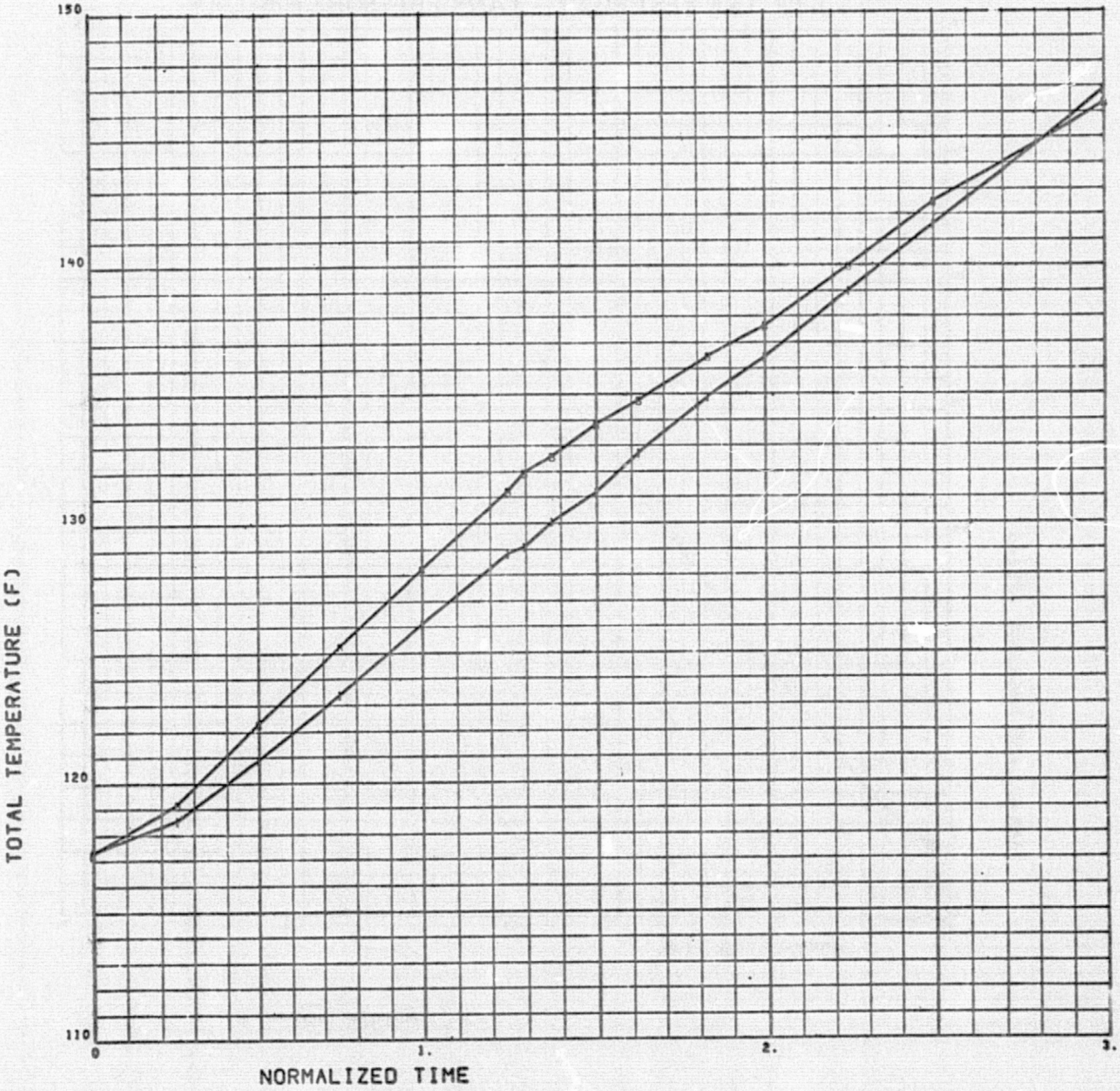
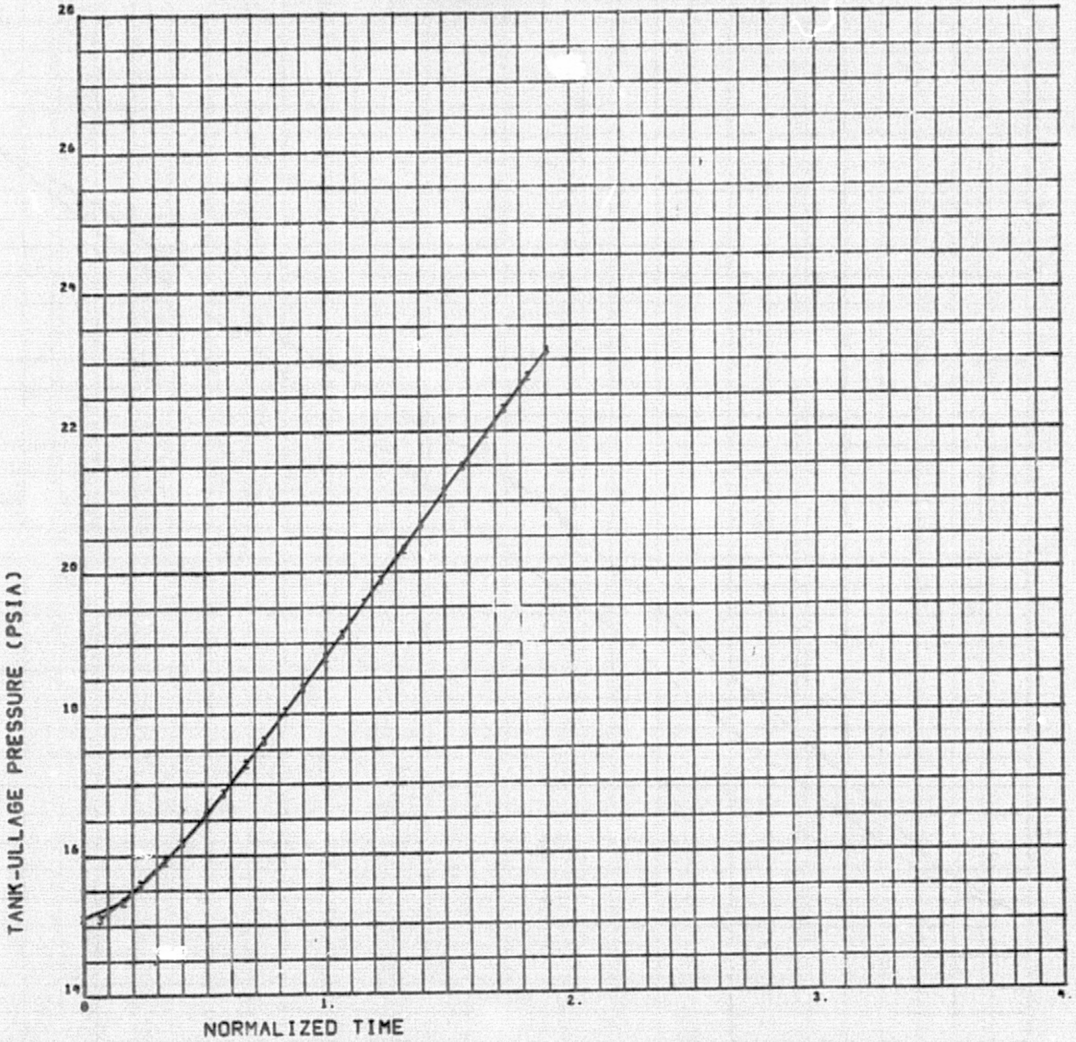


FIGURE 5.1-4d
12 IN. TNK TST1G25 BULK ULGE Y LIQ TEMP HISTORIES



B - ULLAGE
L - LIQUID

FIGURE 5.I-5a
6 IN. TNK TEST 8GΣ2 – TANK PRESSURE HISTORY



2 }
3 } Pressure Transducer

FIGURE 5.1-5b
6 IN. TNK TST8G12S TANK PRESSURE HISTORY

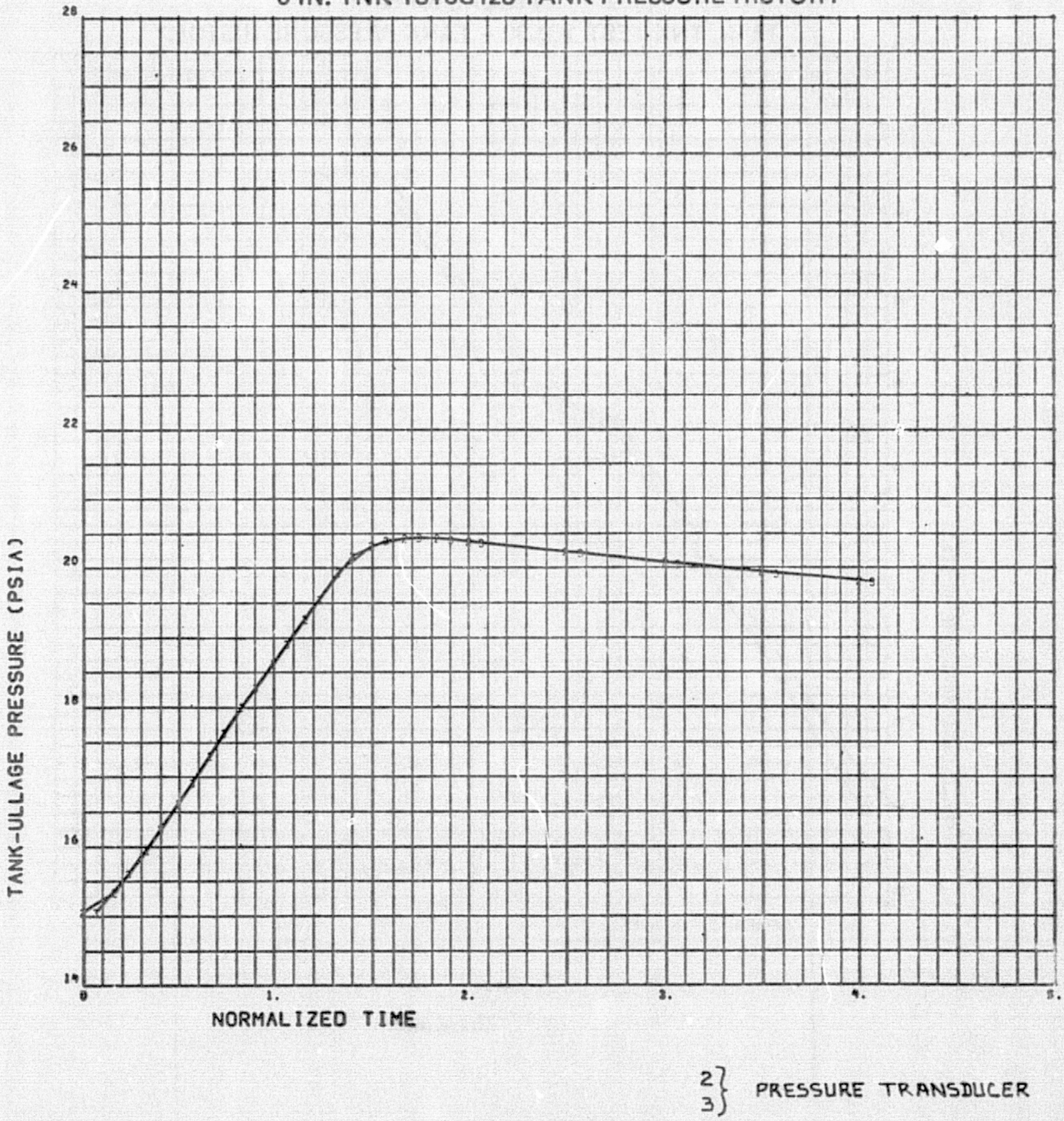
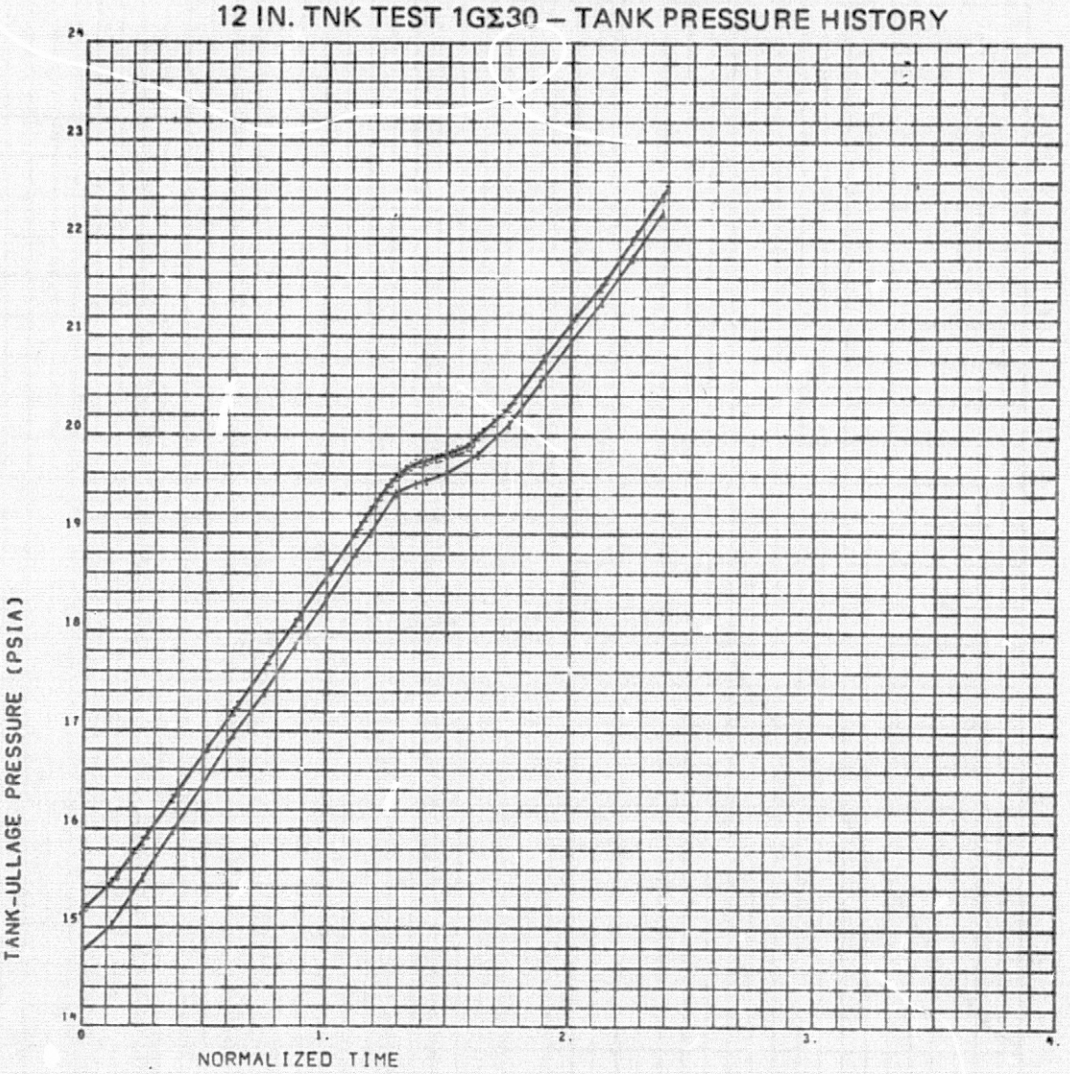


FIGURE 5.1-5c

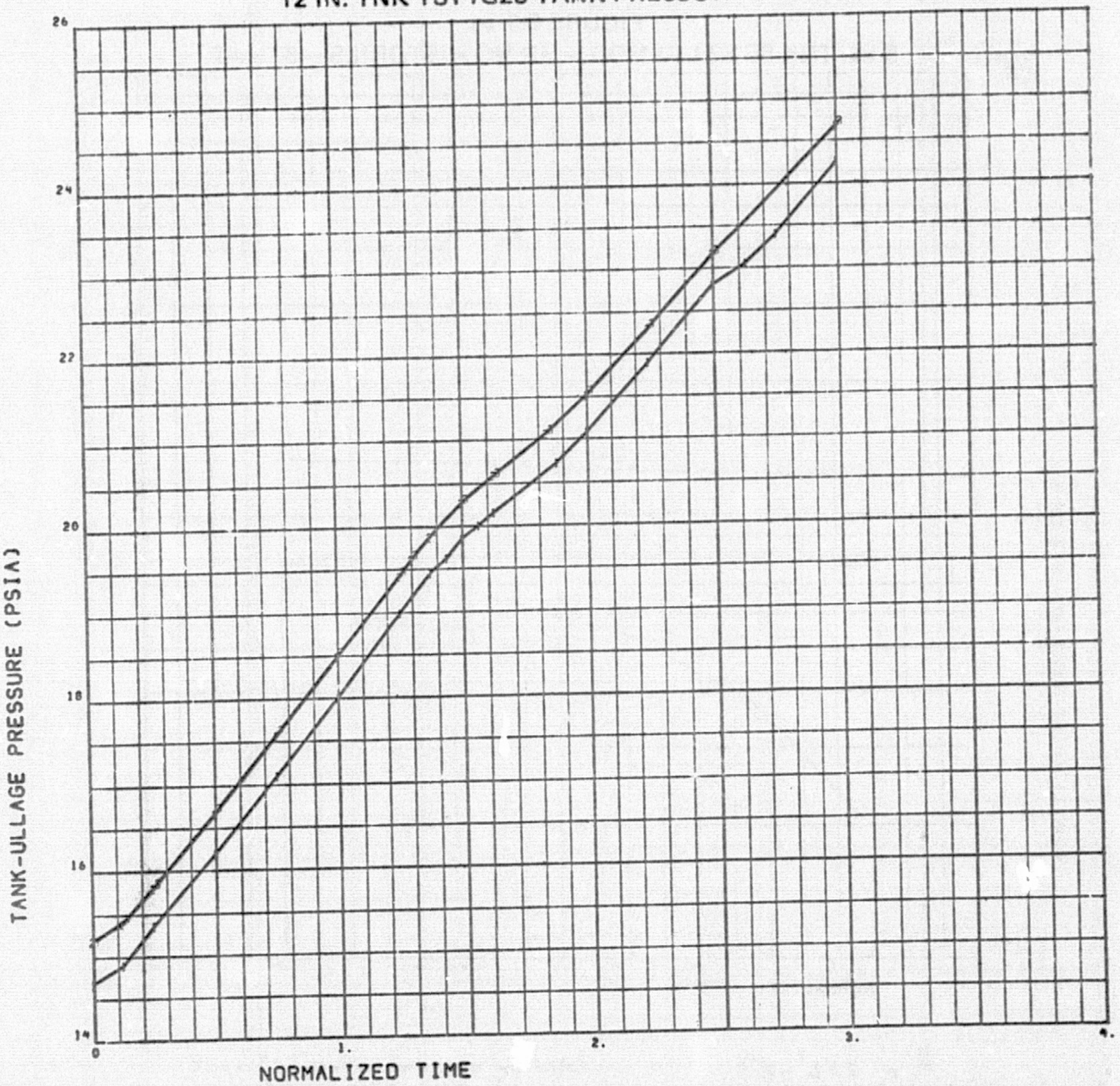
12 IN. TNK TEST 1GΣ30 – TANK PRESSURE HISTORY



1 - Gage

2
3 } - Transducer

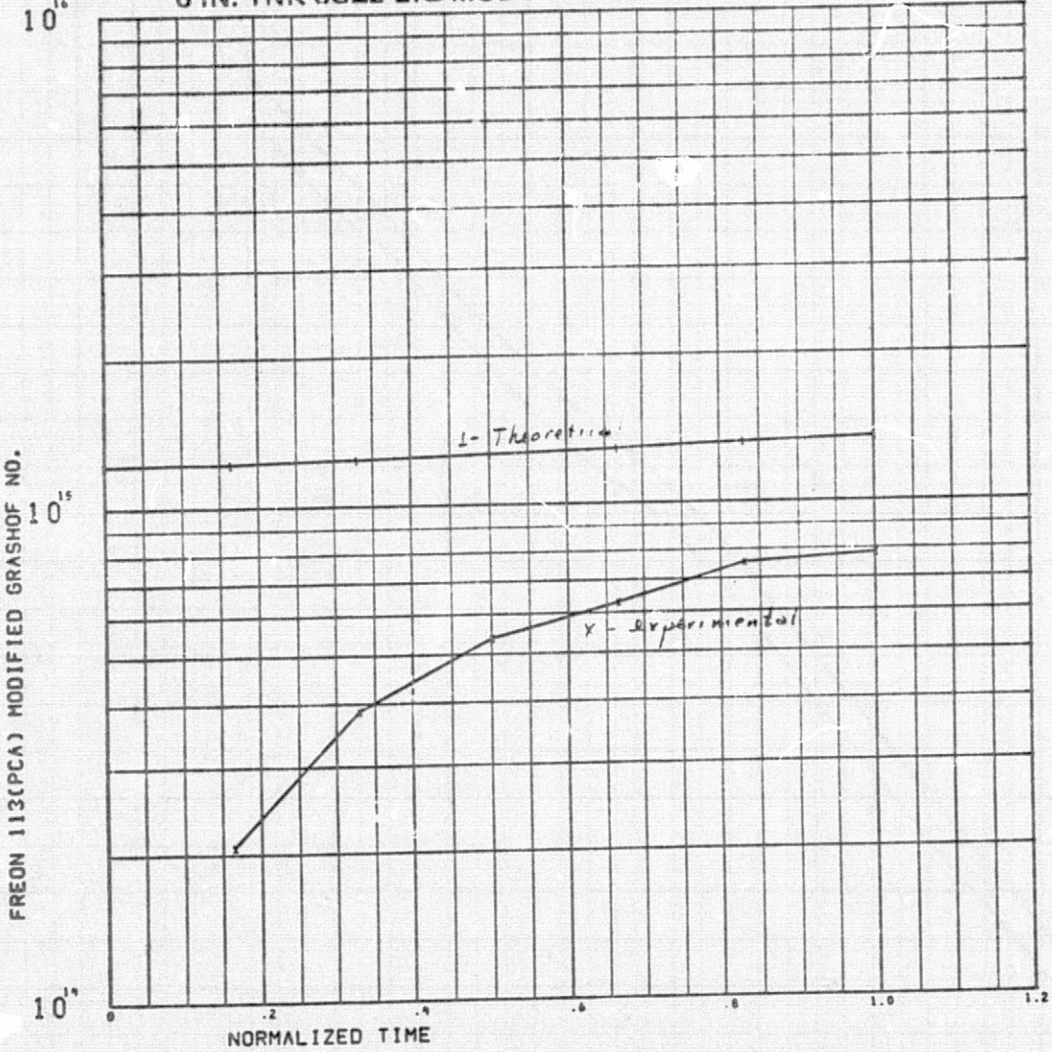
FIGURE 5.1-5d
12 IN. TNK TST1G25 TANK PRESSURE HISTORY



1 - Pressure Gage
2
3 } Pressure Transducer

FIGURE 5.1-6a

6 IN. TNK 8GΣ2 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2}\left(\frac{q''L}{k}\right)$

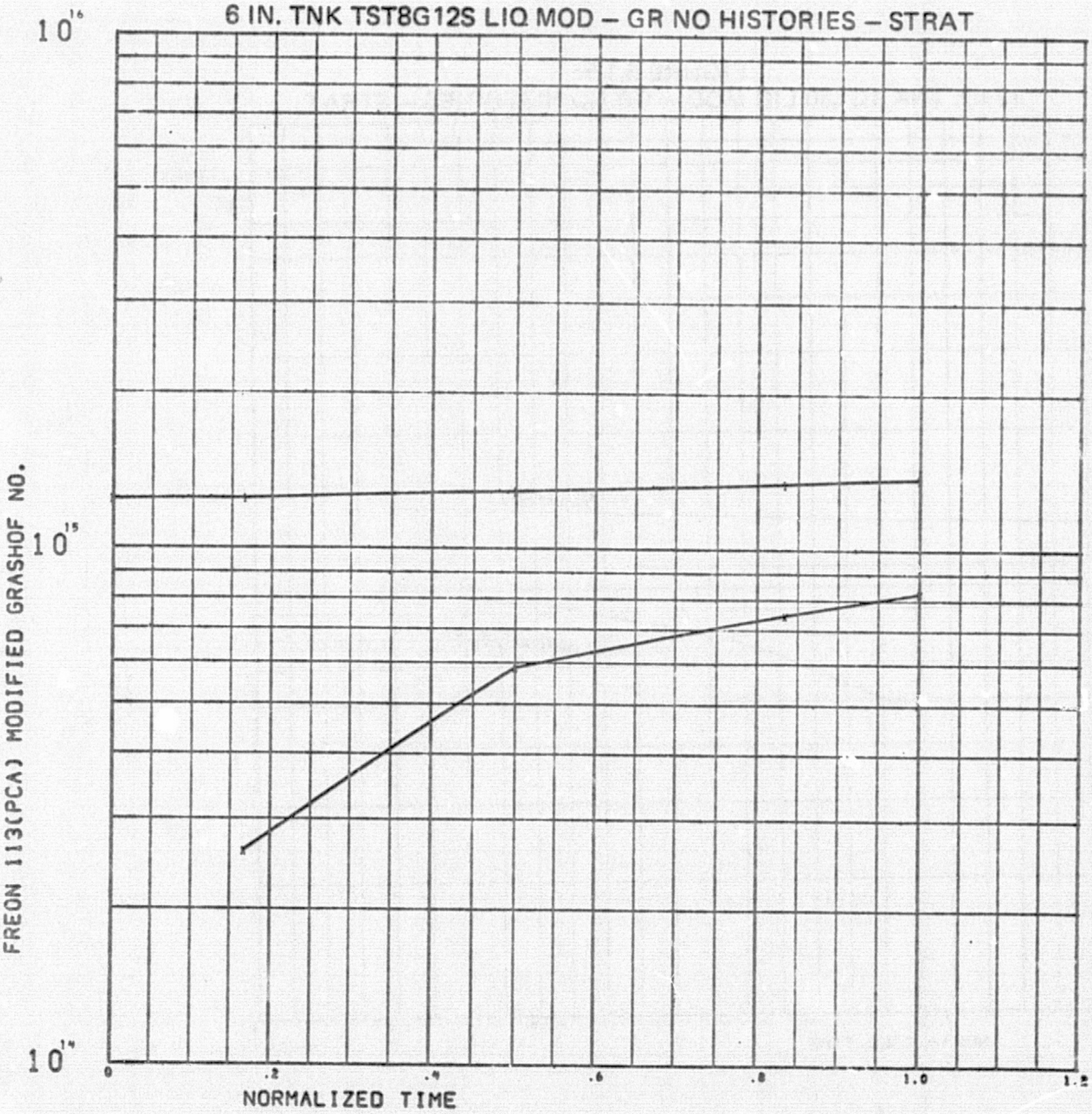
I ... Based on measured wattage; q''_{DH} input

X .. Based on experimentally determined; q''_{liquid}.

L = Liquid (Freon PCA-113) depth

FIGURE 5.1-6b

6 IN. TNK TST8G12S LIQ MOD – GR NO HISTORIES – STRAT



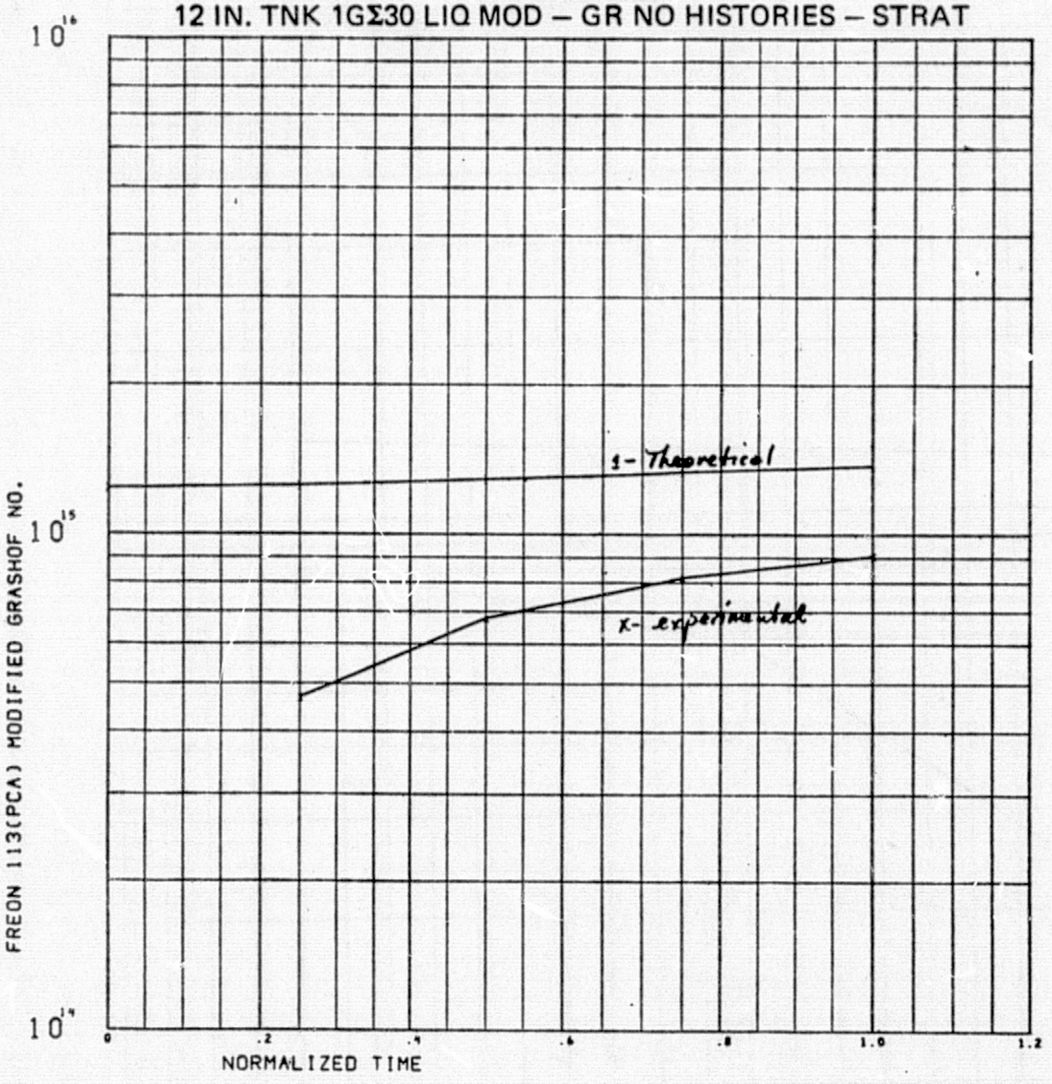
$Gr^{*} = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(q'' \frac{L}{K}\right)$

I THEORETICAL - BASED ON MEASURED q_H'' WATTAGE INPUT

L = FLUID (FREON PCA (113)) DEPTH

X EXPERIMENTAL - BASED ON MEASURED q_l''

FIGURE 5.1-6c
12 IN. TNK 1GΣ30 LIQ MOD – GR NO HISTORIES – STRAT



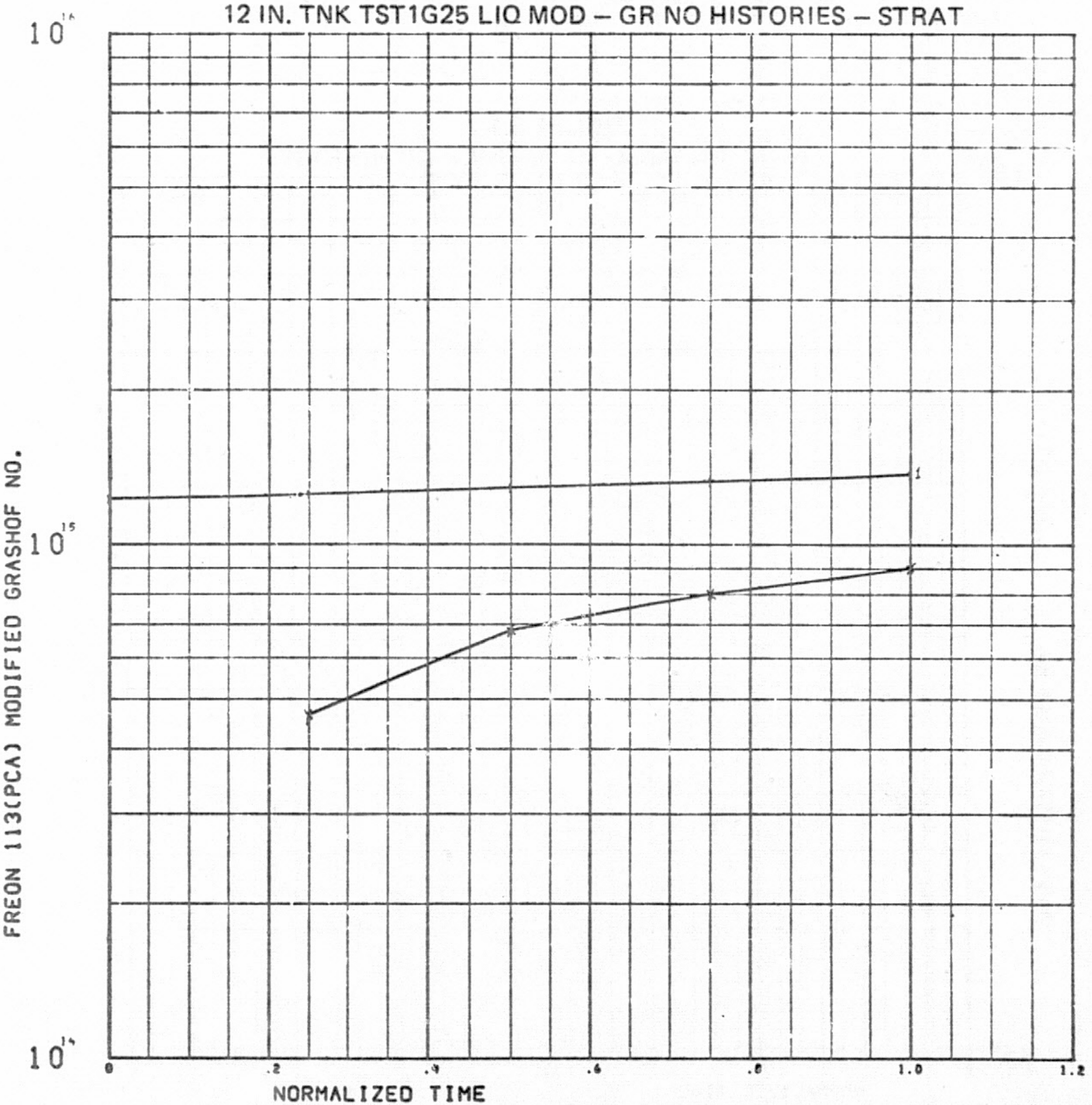
$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q''L}{k}\right)$

1 = Based on q''_H wattage measured input

x = Based on experimentally determined; q''_{fluid}.

L - Fluid depth

FIGURE 5.1-6d
12 IN. TNK TST1G25 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(q''\frac{L}{k}\right)$$

L = Fluid (Freon PCA(113)) depth

1 - Theoretical - based on measured q''_{input} wattage

X - Experimental - based on measured q''_{fluid}

FIGURE 5.1-7a

6 IN. TNK 8GΣ2 LIQ FOURIER NO HISTORY

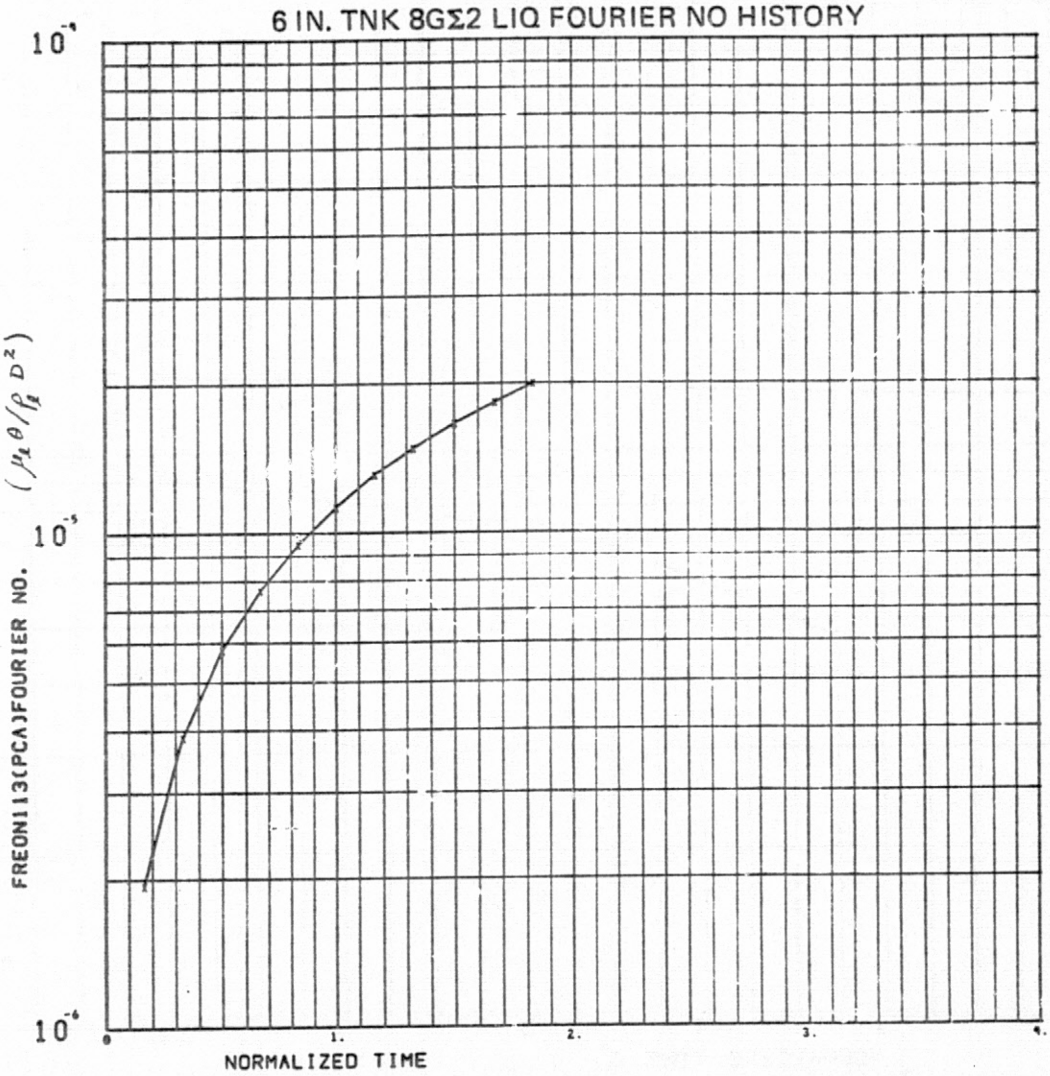


FIGURE 5.1-7b
6 IN. TNK 8G12S LIQ FOURIER NO HISTORY

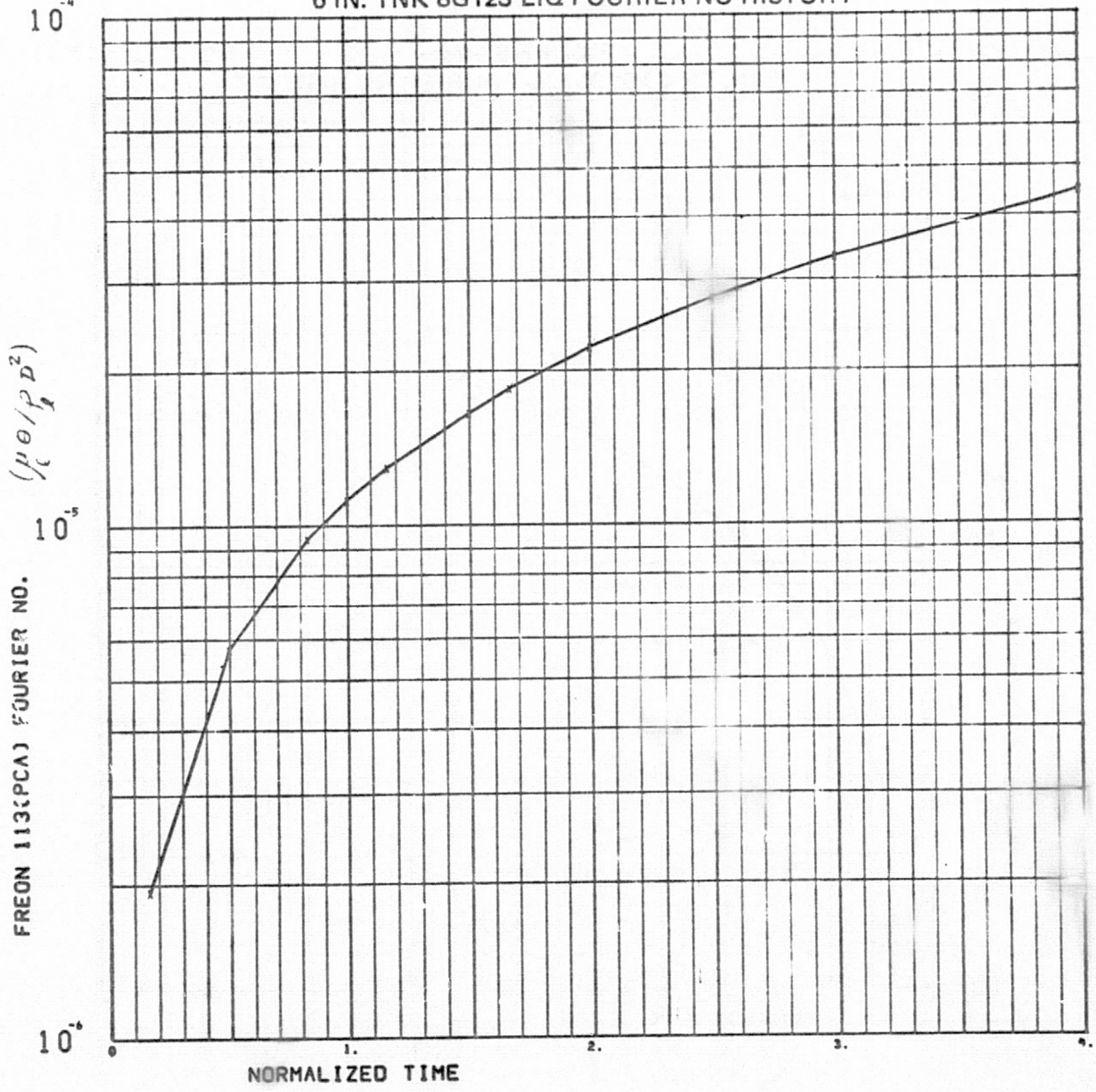


FIGURE 5.1-7c
12 IN. TNK 1GΣ30 LIQ FOURIER NO HISTORY

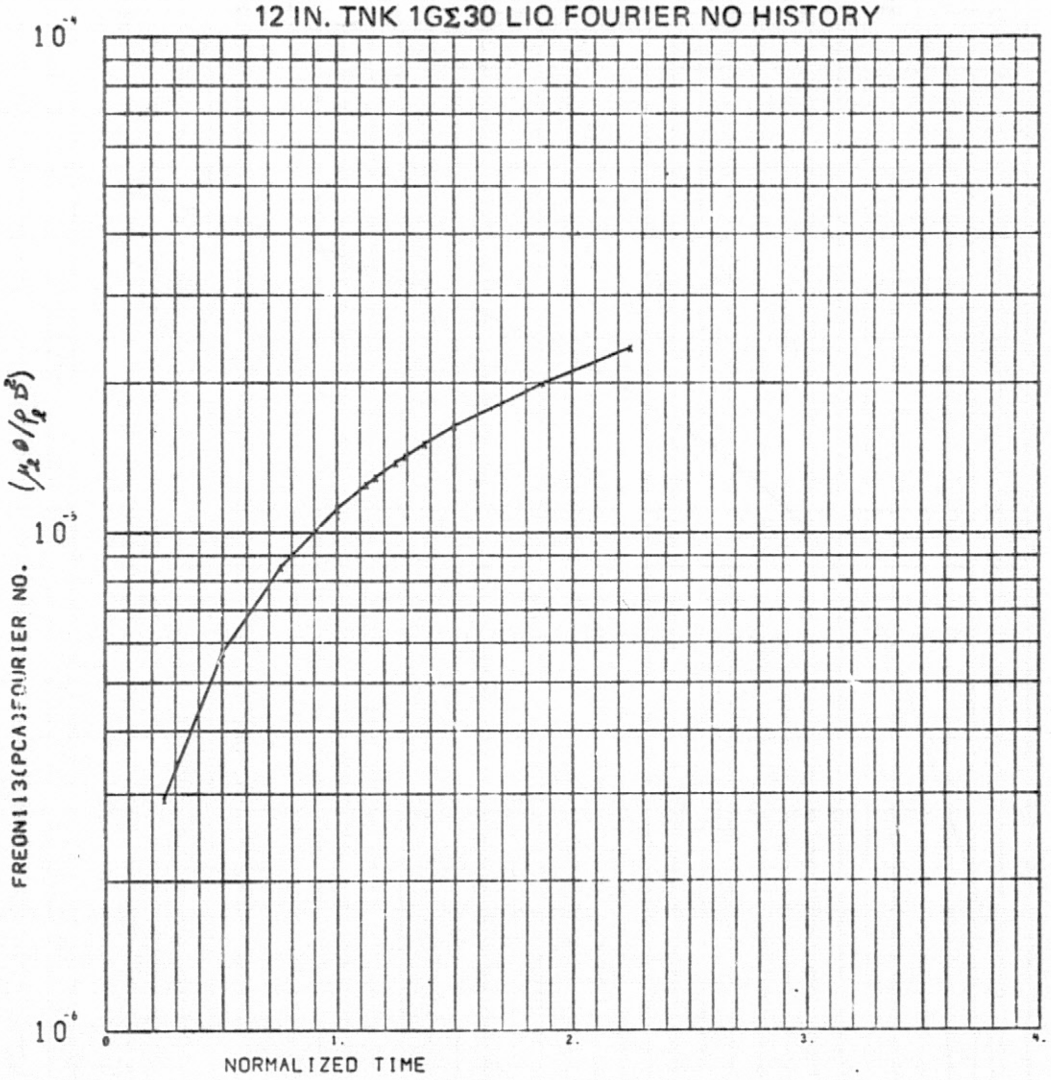
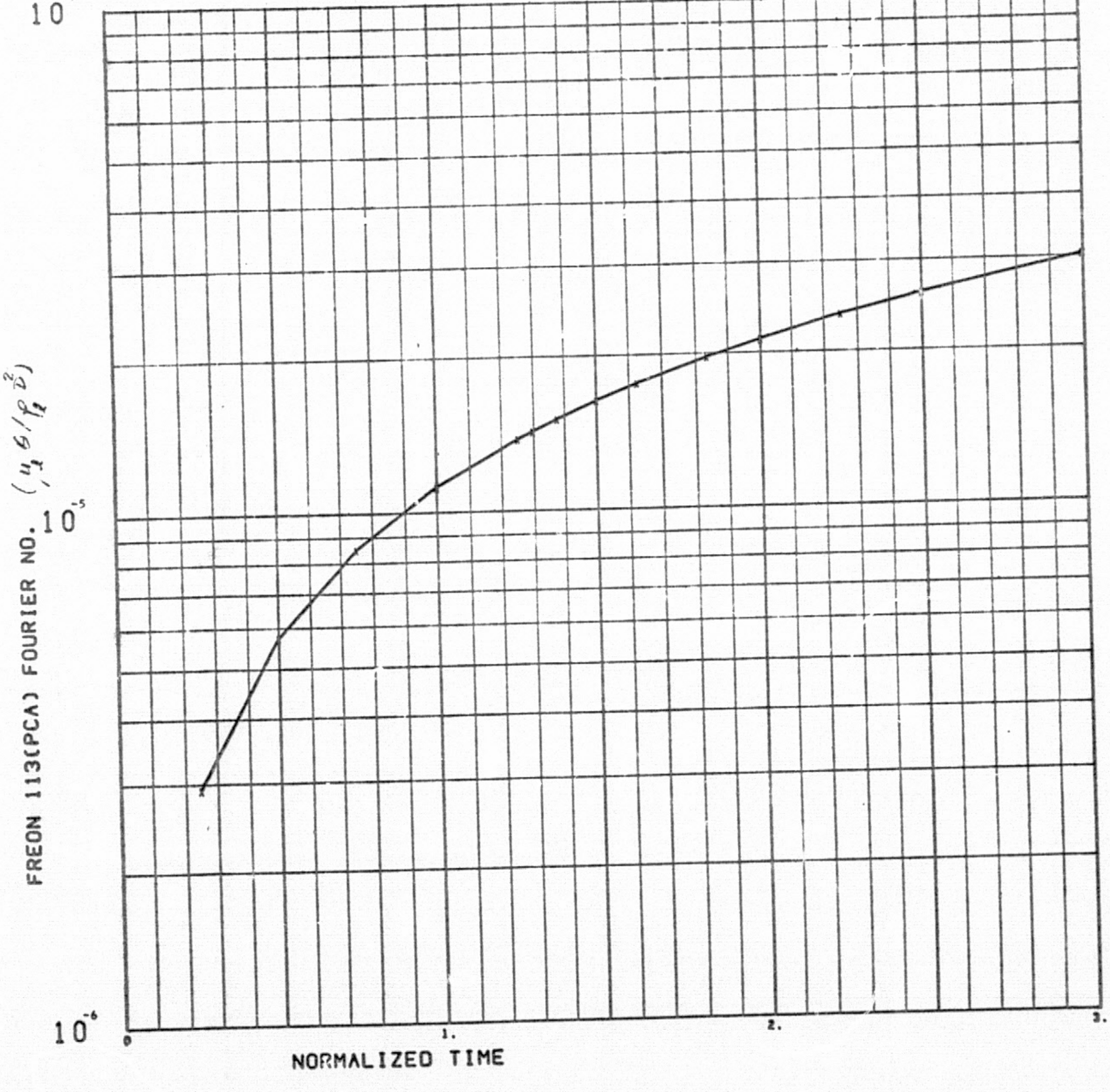


FIGURE 5.1-7d
12 IN. TNK TST1G25 LIQ FOURIER NO HISTORY



Section 5.2

SCALING SET

6-in. -Dia Tank Tests	12-in. -Dia Tank Tests
8G	1G
Test #3 Test #11S	Test #31 Test #17

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Table 5.2-1a. 6 IN. DIA. TANK TEST 8G#3 (Page 1 of 2)

```
          STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=    .3927       CYL AREA FT2=  1.5708       FLNGE AREA FT2=    .0365
DME WALL VOL FT3=    .00131      1/2 CYL WALL VOLFT3=    .00164      FLNGE VOL FT3=    .00076
DME MASS LBM=    .65596      MASS 1/2 CYL LBM=    .81996      FLANGE MASS=    .38058

 LIQ VOL FT3=    .22907      ULLAGE VOL FT3=    .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=1001.9935   H34=1001.9935   H56=1001.9935   H910=1001.9935   H78=1001.9935

EST.HT FLUX IN LIQ (BTU/HR-FT2)=1001.9935
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=1001.9935
EST.HT INPUT LIQ(STRAT)BTU=    65.580       (STRAT+DESTRAT)BTU=   131.161
EST.LIQ TEMP INCRSE(STRAT)=    13.4605F      (STRAT+DESTRAT)=    26.8956F

EST.HT INPUT ULLAGE(STRAT)BTU=    13.116      (STRAT+DESTRAT)BTU=    26.232
```

Table 5.2-1b. 6 IN. DIA. TANK TEST 8G#11S

```
          STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=    .3927       CYL AREA FT2=  1.5708       FLNGE AREA FT2=    .0365
DME WALL VOL FT3=    .00131      1/2 CYL WALL VOLFT3=    .00164      FLNGE VOL FT3=    .00076
DME MASS LBM=    .65596      MASS 1/2 CYL LBM=    .81996      FLANGE MASS=    .38058

 LIQ VOL FT3=    .22907      ULLAGE VOL FT3=    .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=1001.9935   H34=1001.9935   H56=1001.9935   H910=1001.9935   H78=1001.9935

EST.HT FLUX IN LIQ (BTU/HR-FT2)=1001.9935
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=1001.9935
EST.HT INPUT LIQ(STRAT)BTU=    65.580       (STRAT+DESTRAT)BTU=     0.000
EST.LIQ TEMP INCRSE(STRAT)=    13.4618F      (STRAT+DESTRAT)=     0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=    13.116      (STRAT+DESTRAT)BTU=     0.000
```

)

Table 5.2-1c. 12 IN. DIA. TANK TEST 1G#31 (Page 2 of 2)

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=  1,5708       CYL AREA FT2=  6,2832       FLNGE AREA FT2=   ,1458
DME WALL VOL FT3=   ,01047      1/2 CYL WALL VOLFT3=   ,01309     FLNGE VOL FT3=    ,00608
DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965      FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=   ,26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 500,5626   H34= 500,5626   H56= 500,5626   H910= 500,5626   H78= 500,5626

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 500,5626
EST,HT FLUX IN ULLGE (BTU/HR-FT2)= 500,5626
EST,HT INPUT LIQ(STRAT)BTU=  524,188      (STRAT+DESTRAT)BTU=  952,852
EST,LIQ TEMP INCRSE(STRAT)=   13,4462F      (STRAT+DESTRAT)=   25,1829F

EST,HT INPUT ULLAGE(STRAT)BTU=  104,838      (STRAT+DESTRAT)BTU=  196,570
```

Table 5.2-1d. 12 IN. DIA. TANK TEST 1G#17

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=  1,5708       CYL AREA FT2=  6,2832       FLNGE AREA FT2=   ,1458
DME WALL VOL FT3=   ,01047      1/2 CYL WALL VOLFT3=   ,01309     FLNGE VOL FT3=    ,00608
DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965      FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=   ,26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 500,5626   H34= 500,5626   H56= 500,5626   H910= 500,5626   H78= 500,5626

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 500,5626
EST,HT FLUX IN ULLGE (BTU/HR-FT2)= 500,5626
EST,HT INPUT LIQ(STRAT)BTU=  524,188      (STRAT+DESTRAT)BTU=  906,406
EST,LIQ TEMP INCRSE(STRAT)=   13,4459F      (STRAT+DESTRAT)=   23,2291F

EST,HT INPUT ULLAGE(STRAT)BTU=  104,838      (STRAT+DESTRAT)BTU=  181,281
```

Table 5.2-2a. 6 IN. DIA TANK TEST 8G #3 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	,333	,667	1,000	1,333	1,667	2,000
TAU	0,000	,167	,334	,500	,666	,834	1,000
1	116,000	118,917	122,625	125,708	129,042	131,958	135,083
2	116,958	123,875	130,792	134,833	138,208	141,833	144,500
3	117,125	122,625	128,833	132,833	135,958	139,375	141,958
4	117,375	123,458	129,125	133,083	136,042	138,625	140,917
5	116,708	121,625	126,750	130,333	133,333	135,625	137,708
6	116,750	121,917	126,958	129,958	132,667	134,833	136,625
7	116,833	122,333	127,625	129,875	132,333	134,292	136,125
8	116,958	122,750	127,208	128,958	130,750	132,375	134,417
9	115,042	117,458	119,625	121,250	122,500	123,625	125,125
10	116,833	127,917	132,542	136,125	139,625	142,417	145,292
11	116,875	128,708	133,875	136,875	140,417	142,917	145,125
12	117,250	129,417	134,917	137,500	139,917	142,250	144,458
13	116,542	127,875	132,833	134,917	136,417	137,417	139,042
14	116,000	118,917	122,625	125,708	129,042	131,958	135,083
15	116,167	122,125	127,250	130,750	132,958	135,917	138,958
16	116,542	122,958	127,875	131,167	134,083	136,333	138,250
17	116,000	120,792	124,500	127,417	129,750	131,708	133,792
18	115,375	120,500	124,833	126,708	128,750	130,917	132,667
19	114,708	116,542	118,833	120,125	121,542	123,250	124,708
20	116,833	127,917	132,542	136,125	139,625	142,417	145,292
21	116,875	128,708	133,875	136,875	140,417	142,917	145,125
22	117,250	129,417	134,917	137,500	139,917	142,250	144,458
23	116,542	127,875	132,833	134,917	136,417	137,417	139,042
24	116,292	134,167	153,792	172,167	189,083	204,708	219,167
25	115,958	119,583	123,042	126,917	131,542	139,208	149,583
26	115,833	118,958	122,125	125,375	128,833	132,083	135,542
27	114,792	119,042	122,042	125,292	128,792	132,125	135,625
28	116,375	120,458	125,000	130,917	137,917	145,625	154,125
29	116,000	125,792	135,958	145,458	155,292	164,958	174,542
30	116,375	140,458	164,792	186,750	206,875	224,625	241,000
31	116,042	126,896	131,125	132,354	132,771	133,458	134,167
32	116,750	127,708	132,125	133,333	133,542	134,250	135,000
33	114,750	117,083	119,708	121,125	122,333	123,083	124,000
34	110,375	111,750	113,292	114,917	116,708	117,917	119,167

Table 5.2-2a. 6 IN. DIA TANK TEST 8G #3 (Page 2 of 2)

35	105,500	106,500	107,583	108,917	110,375	111,625	113,083
36	115,333	126,083	130,125	131,375	132,000	132,667	133,333
37	116,708	120,000	126,208	132,250	144,292	155,000	166,583
38	116,667	119,583	122,958	127,375	133,125	138,667	154,375
~~39~~	~~116,833~~	~~119,958~~	~~123,125~~	~~127,833~~	~~132,875~~	~~140,333~~	~~149,167~~
40	117,250	120,125	123,167	126,833	132,583	137,417	142,042
41	116,792	119,542	121,750	124,458	127,958	130,875	133,750
42	116,917	119,375	121,875	124,500	127,958	130,875	134,042
43	117,083	120,042	122,167	124,750	127,875	131,083	133,833
44	117,167	119,750	122,083	124,875	128,667	132,000	135,917
~~45~~	~~117,083~~	~~120,375~~	~~122,333~~	~~124,792~~	~~127,750~~	~~130,417~~	~~133,458~~
46	117,000	119,625	122,292	125,167	128,583	132,125	134,375
47	117,375	120,792	123,333	126,250	130,042	132,083	134,875
48	117,792	119,167	121,625	124,208	127,667	130,167	132,208
49	116,458	117,917	119,833	122,583	125,125	127,750	130,542
50	116,750	117,750	119,542	122,333	124,458	127,500	129,667
~~51~~	~~116,500~~	~~117,625~~	~~120,667~~	~~121,417~~	~~123,708~~	~~126,375~~	~~128,542~~
52	117,188	118,125	120,500	122,354	124,563	126,708	129,375
53	116,458	117,375	119,458	122,000	124,667	126,000	128,667
54	117,875	118,625	120,333	123,292	125,417	127,042	130,208
55	117,708	118,750	120,750	123,042	125,292	129,042	130,167
56	117,875	118,625	120,333	123,292	125,417	127,042	130,208
~~57~~	~~117,708~~	~~118,750~~	~~120,750~~	~~123,042~~	~~125,292~~	~~128,042~~	~~130,167~~
58	116,542	116,833	119,250	121,542	123,208	125,375	127,875
59	117,458	117,875	119,500	121,667	123,875	126,042	127,708
60	118,792	118,958	120,583	122,375	124,708	126,792	129,042
61	116,083	116,000	116,875	118,542	119,542	122,458	123,292
62	116,375	116,167	116,792	118,792	119,417	121,750	123,667
~~63~~	~~117,083~~	~~117,042~~	~~117,625~~	~~119,708~~	~~120,625~~	~~123,292~~	~~125,042~~
64	118,125	118,042	118,833	120,250	122,083	122,792	124,542
65	115,917	115,958	116,000	117,292	118,208	119,833	121,375
66	116,125	116,042	115,833	116,750	117,708	119,333	120,375
67	116,625	116,875	116,542	117,625	118,500	119,958	121,250
68	117,583	117,667	117,750	118,583	119,167	120,042	121,667
~~69~~	~~115,875~~	~~115,792~~	~~115,708~~	~~116,375~~	~~116,792~~	~~117,958~~	~~119,167~~
70	116,000	115,917	115,792	116,667	116,875	118,167	119,042
71	116,292	116,375	116,417	117,125	117,375	118,583	119,500
72	117,333	117,500	117,625	118,708	119,250	120,625	121,583
73	115,250	115,625	116,667	117,667	118,083	119,000	119,875
74	106,167	106,375	106,958	108,000	109,000	110,333	111,792
~~75~~	~~91,167~~	~~91,083~~	~~90,917~~	~~91,167~~	~~90,917~~	~~91,208~~	~~91,250~~
76	104,292	104,333	104,333	104,833	105,042	105,625	106,125
77	89,875	89,667	89,375	89,458	89,125	89,208	89,042

Table 5.2-2b. 6 IN. DIA TANK TEST 8G #11S (Page 1 of 2)

TEMPERATURF MATRIX-STRATIFICATION

TIMF (MIN)	0.000	.333	1.000	1.667	2.000
TAU	0.000	.167	.500	.833	1.000
1	116.833	120.583	128.917	135.750	139.542
2	117.125	124.000	134.458	140.833	143.625
3	117.375	122.958	132.792	138.958	141.458
4	117.500	123.583	132.958	138.167	140.292
5	116.667	121.917	130.417	134.917	137.083
6	116.500	122.167	130.083	134.458	136.250
7	116.375	122.250	129.583	133.521	135.833
8	116.250	122.333	129.042	132.583	135.417
9	114.875	116.833	121.042	123.750	125.583
10	117.167	126.583	136.667	142.333	145.208
11	117.042	129.000	137.250	142.750	144.875
12	116.583	129.000	137.583	141.958	143.792
13	115.500	126.708	133.833	136.708	138.083
14	115.583	118.833	125.667	131.458	134.542
15	116.292	122.250	130.083	135.542	138.250
16	116.792	123.167	131.083	135.333	137.917
17	115.813	121.542	128.792	132.729	134.833
18	114.833	119.917	126.500	130.125	131.750
19	114.208	115.667	119.417	122.292	123.667
20	117.167	128.583	136.667	142.333	145.208
21	117.042	129.000	137.250	142.750	144.875
22	116.583	129.000	137.583	141.958	143.792
23	115.500	126.708	133.833	136.708	138.083
24	116.417	135.542	172.708	202.750	215.833
25	115.917	120.000	127.208	134.000	138.708
26	111.313	119.458	126.250	132.542	136.479
27	106.708	118.917	125.292	131.083	134.250
28	116.167	120.292	131.250	145.792	154.042
29	116.167	126.250	146.250	165.667	175.167
30	117.458	142.750	189.458	226.292	241.542
31	115.847	125.069	129.722	131.722	132.639
32	116.708	125.875	130.583	132.583	133.250
33	114.042	116.125	119.833	121.958	122.750
34	112.417	113.083	115.208	117.167	117.875

Table 5.2-2b. 6 IN. DIA TANK TEST 8G #11S (Page 2 of 2)

35	110.917	110.917	111.750	112.750	113.208
36	115.417	124.667	129.292	131.292	132.333
~~37~~	~~116.667~~	~~120.792~~	~~135.167~~	~~154.417~~	~~166.833~~
38	116.667	119.833	127.875	141.500	154.250
39	117.000	120.042	127.708	139.250	147.667
~~40~~	~~117.292~~	~~120.250~~	~~127.375~~	~~135.833~~	~~139.667~~
41	117.208	119.292	124.833	130.375	133.083
42	117.208	119.208	124.833	130.667	133.625
~~43~~	~~117.500~~	~~119.500~~	~~125.292~~	~~130.750~~	~~133.333~~
44	117.583	119.708	125.542	132.500	135.167
45	117.458	120.042	124.708	130.333	132.833
~~46~~	~~117.375~~	~~119.708~~	~~126.208~~	~~131.000~~	~~134.042~~
47	117.958	120.917	126.125	132.208	134.625
48	118.167	119.500	124.917	130.208	132.417
~~49~~	~~115.875~~	~~117.042~~	~~122.083~~	~~126.833~~	~~129.125~~
50	116.375	117.417	121.708	126.917	129.250
51	116.125	116.542	120.500	125.542	128.208
~~52~~	~~116.979~~	~~117.396~~	~~121.667~~	~~126.083~~	~~128.271~~
53	115.667	116.333	121.542	125.250	127.458
54	117.833	118.250	122.833	126.625	128.333
~~55~~	~~117.542~~	~~117.917~~	~~122.500~~	~~126.833~~	~~129.542~~
56	117.833	118.250	122.833	126.625	128.333
57	117.542	117.917	122.500	126.833	129.542
~~58~~	~~115.833~~	~~116.208~~	~~121.375~~	~~124.875~~	~~126.875~~
59	117.083	117.542	121.208	124.958	127.333
60	118.500	119.042	122.083	126.458	128.208
~~61~~	~~115.042~~	~~115.375~~	~~117.167~~	~~120.625~~	~~122.667~~
62	114.875	115.542	117.542	120.833	122.417
63	115.958	116.458	118.542	122.042	123.917
~~64~~	~~117.167~~	~~117.792~~	~~119.542~~	~~122.375~~	~~123.750~~
65	114.167	114.667	115.750	118.625	120.667
66	114.250	114.500	115.542	118.125	119.500
~~67~~	~~115.292~~	~~115.417~~	~~116.417~~	~~118.917~~	~~120.292~~
68	116.167	116.208	116.875	119.042	120.167
69	113.458	113.792	114.917	116.792	118.042
~~70~~	~~113.792~~	~~114.000~~	~~115.208~~	~~116.667~~	~~117.958~~
71	114.375	114.750	115.708	117.417	118.875
72	115.500	116.292	117.667	119.708	120.667
~~73~~	~~113.167~~	~~114.083~~	~~115.875~~	~~117.542~~	~~119.250~~
74	109.250	110.125	112.125	115.500	117.500
75	97.125	97.708	98.292	99.292	100.042
76	104.917	105.250	105.542	106.500	107.208
77	90.625	90.792	90.542	90.292	90.500

Table 5.2-2c. 12 IN. DIA TANK TEST 1G #31 (Page 1 of 2)

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                      TEMPERATURE MATRIX=STRATIFICATION



TIME(MIN)    0,000     2,000     4,000     6,000     8,000
TAU          0,000      ,250      ,500      ,750     1,000
   1       117,292 124,208 128,083 131,833 135,625
   2       117,458 126,292 130,583 133,958 137,333
   3       117,792 127,583 131,667 134,917 138,042
   4       117,958 127,417 130,625 133,667 136,833
   5       117,833 127,792 131,333 133,917 136,875
   6       117,875 126,083 128,875 131,417 134,208
   7       117,875 125,875 128,375 130,708 133,375
   8       117,875 126,125 128,542 130,833 133,458
   9       117,542 121,958 124,667 127,250 129,792
  10       117,583 135,208 138,958 142,375 145,792
  11       117,667 135,042 138,167 141,292 144,333
  12       118,000 133,583 136,542 139,208 142,042
  13       117,792 135,125 137,333 139,542 141,750
  14       117,000 124,000 127,792 131,500 135,167
  15       117,583 131,833 136,042 139,625 142,792
  16       117,708 130,917 134,208 137,500 142,250
  17       117,625 130,958 133,875 136,708 139,542
  18       117,542 129,417 131,750 134,333 137,000
  19       117,167 121,333 123,750 126,250 128,625
  20       117,917 135,083 139,042 142,500 145,750
  21       117,750 135,417 138,583 141,792 144,583
  22       118,125 134,208 136,958 139,625 142,375
  23       118,042 134,583 136,750 138,875 141,708
  24       116,500 141,417 162,000 170,250 177,000
  25       116,208 125,542 135,417 145,042 154,125
  26       115,000 122,750 129,875 137,458 146,000
  27       115,875 122,708 129,750 137,458 145,958
  28       118,208 138,417 161,917 187,292 213,000
  29       117,333 130,375 146,417 162,792 179,667
  30       118,042 141,417 180,542 204,958 224,208
  31       118,625 134,333 136,542 138,542 141,167
  32       118,375 132,458 134,375 136,708 138,958
  33       116,292 121,333 123,083 124,708 126,667
  34       115,792 115,583 115,750 116,042 116,708
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Table 5.2-2c. 12 IN. DIA TANK TEST 1G NO. 31 (Page 2 of 2)

35	115,542	114,833	114,375	113,875	113,625
36	119,167	134,375	136,667	138,708	141,083
37	118,208	132,125	154,167	178,667	202,292
38	117,958	127,000	142,167	154,167	169,208
39	117,417	123,208	130,333	138,000	146,833
40	117,417	123,250	130,292	137,792	144,125
41	117,542	120,708	123,667	126,833	130,292
42	117,583	120,750	124,375	127,792	131,125
43	117,708	120,792	124,375	127,750	131,083
44	117,792	120,375	124,542	128,042	131,417
45	117,667	120,542	124,333	127,625	131,417
46	117,542	121,250	125,333	128,583	132,125
47	117,750	121,083	124,375	128,083	131,500
48	118,042	121,000	123,875	127,250	130,792
49	117,896	120,500	123,375	126,708	131,125
50	117,750	120,000	122,833	126,208	129,458
51	117,667	118,958	121,625	124,583	127,333
52	117,583	119,500	122,625	125,875	129,042
53	117,458	120,292	123,083	126,208	129,417
54	117,750	119,792	122,792	126,000	129,167
55	117,583	119,833	122,792	125,958	129,208
56	117,625	119,375	122,583	125,792	128,875
57	117,542	119,750	123,042	126,042	129,250
58	117,667	119,417	122,333	125,458	126,750
59	117,500	119,125	121,917	125,000	128,083
60	117,333	119,000	121,708	124,708	127,542
61	117,417	118,667	121,208	123,708	126,542
62	117,625	118,708	121,042	123,792	126,583
63	117,333	118,542	120,875	123,500	126,292
64	117,292	118,292	120,500	122,958	125,708
65	117,417	118,333	120,458	123,125	125,792
66	117,333	118,042	120,000	122,333	124,917
67	117,333	118,042	120,000	122,333	124,917
68	117,250	117,875	119,625	121,833	124,333
69	117,333	117,875	119,708	121,917	124,375
70	117,208	117,792	119,417	121,625	124,000
71	117,208	117,792	119,417	121,625	124,000
72	117,250	118,083	119,792	121,708	124,125
▼73	117,292	117,875	119,667	121,542	124,000
74	96,250	96,417	96,875	97,542	98,250
75	106,083	106,958	108,500	110,292	112,292
76	68,792	88,792	88,875	88,875	88,917
77	99,458	99,500	99,583	99,792	100,208

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Table 5.2-2d. 12 IN. DIA TANK TEST 1G #17 (Page 1 of 2)

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                    TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)   0,000    1,000    2,000    4,000    6,000    8,000
TAU         0.000     .125     .250     .500     .750    1,000
   1      117,208  120,708  123,583  127.625  131,500  135,333
   2      117,083  122,708  126,417  130,667  134,333  137,667
   3      117,417  123,042  127,458  131.333  134,625  137,792
   4      117,708  123,958  127,042  130.250  133,583  136,583
   5      117,458  123,542  127,167  131,083  134.125  137,083
   6      117,417  123,333  125,958  128,958  132,042  134,625
   7      117,542  123,208  125,583  128,250  130,583  133,292
   8      117,583  122,958  126,000  128,542  130,708  133,083
   9      117,083  119,750  121,542  124,250  126,917  129,375
  10      117,417  131,542  135,667  139,917  143,000  146,625
  11      117,542  131,875  136,042  139,125  141,667  144,875
  12      117,625  129,625  133,750  136,417  139,417  142,208
  13      117,417  131,167  134,708  137,292  139,583  142,042
  14      117,000  120,458  123,250  127,167  130,833  134,375
  15      117,458  126,208  130,500  135,250  138,667  142,083
  16      117,542  125,708  129,958  133,500  136,583  139,333
  17      117,333  126,208  130,292  133,375  136,333  139,125
  18      117,208  124,875  128,292  131,208  133,458  136,250
  19      116,750  119,250  120,750  123,375  125,792  128,292
  20      118,042  131,875  135,750  139,667  143,208  146,708
  21      117,667  132,125  135,792  139,208  142,208  145,042
  22      117,625  130,458  134,208  136,833  139,958  142,375
  23      117,625  130,792  134,625  136,792  139,292  141,500
  24      117,500  130,042  140,208  158,708  168,958  177,292
  25      117,583  121,167  125,875  134,958  143,167  151,458
  26      117,167  119,458  122,500  128,833  135,333  143,208
  27      117,167  119,542  122,542  128,792  135,333  143,375
  28      125,083  134,708  144,667  166,917  191,417  174,958
  29      123,000  129,375  136,125  150,458  166,208  182,542
  30      120,125  135,750  152,750  182,792  165,250  184,042
  31      118,083  130,667  133,958  136,292  138,625  141,042
  32      117,708  128,833  132,125  134,583  136,542  138,875
  33      114,958  118,292  120,708  122,583  124,250  126,042
  34      114,625  114,417  114,500  114,667  114,875  115,292
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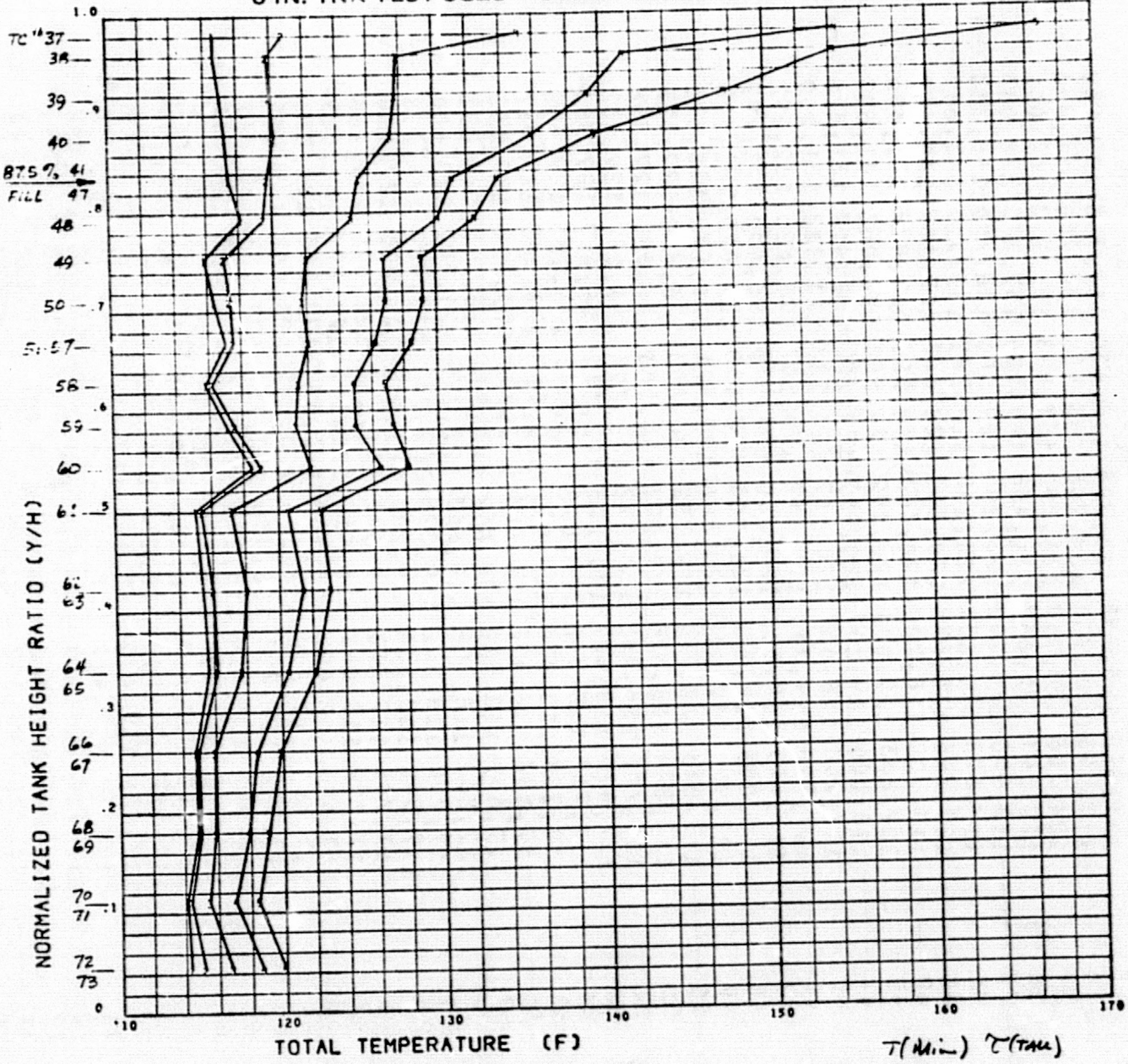
Table 5.2-2d. 12 IN. DIA TANK TEST 1G #17 (Page 2 of 2)

35	114,375	113,958	113,708	113,125	112,708	112,250
36	118,458	130,833	134,208	136,500	138,750	141,333
37	124,708	128,917	136,792	157,833	181,292	163,000
38	122,167	125,667	131,458	145,500	157,375	171,083
39	118,958	120,292	123,208	129,500	136,750	148,333
40	117,625	120,125	123,208	129,542	135,917	143,667
41	117,708	118,875	120,667	123,667	127,167	130,417
42	117,708	118,708	120,833	124,500	127,875	131,458
43	117,833	119,000	120,792	124,500	128,000	131,583
44	118,000	119,167	120,917	124,625	128,417	131,875
45	117,708	118,667	120,167	124,333	127,833	131,500
46	117,750	119,333	121,042	125,167	128,625	132,292
47	117,875	119,000	120,750	124,583	128,458	131,792
48	118,083	119,292	121,000	123,958	127,625	131,125
49	117,958	119,042	120,396	123,521	126,938	130,375
50	117,833	118,792	119,792	123,083	126,250	129,625
51	117,875	118,375	119,292	121,583	124,625	127,458
52	117,750	118,542	119,792	122,708	126,167	129,333
53	117,625	118,667	120,208	123,375	126,417	129,583
54	117,917	118,542	120,000	123,042	126,250	129,458
55	117,708	118,333	119,875	122,917	126,083	129,417
56	117,833	118,458	119,583	122,750	125,917	129,083
57	117,667	118,542	120,042	123,333	126,375	129,333
58	117,833	118,458	119,667	122,375	125,792	129,000
59	117,708	118,042	119,375	122,042	125,000	128,208
60	117,542	118,000	119,208	121,917	124,875	127,750
61	117,708	117,833	119,042	121,167	123,875	126,708
62	117,792	118,042	118,917	121,125	123,875	126,625
63	117,583	117,625	118,708	120,833	123,583	126,375
64	117,458	117,625	118,500	120,542	123,042	125,875
65	117,542	117,708	118,458	120,750	123,125	125,875
66	117,500	117,514	118,250	120,111	122,403	125,042
67	117,542	117,500	118,250	120,125	122,333	124,958
68	117,500	117,417	118,000	119,667	121,833	124,292
69	117,542	117,500	118,083	119,750	121,875	124,375
70	117,444	117,472	117,972	119,611	121,736	124,222
71	117,417	117,417	117,958	119,500	121,500	124,042
72	117,417	117,583	117,958	119,667	121,875	124,333
73	117,500	117,583	118,167	119,708	121,875	124,083
74	93,250	93,333	93,583	94,000	94,583	95,250
75	105,125	105,333	105,958	107,375	108,917	110,708
76	82,083	82,083	82,208	82,250	82,250	82,417
77	93,958	93,875	94,042	94,167	94,375	94,875

FIGURE 5.2-1a

6 IN. TNK TEST 8GΣ3 – STRAT TEMPERATURE PROFILE

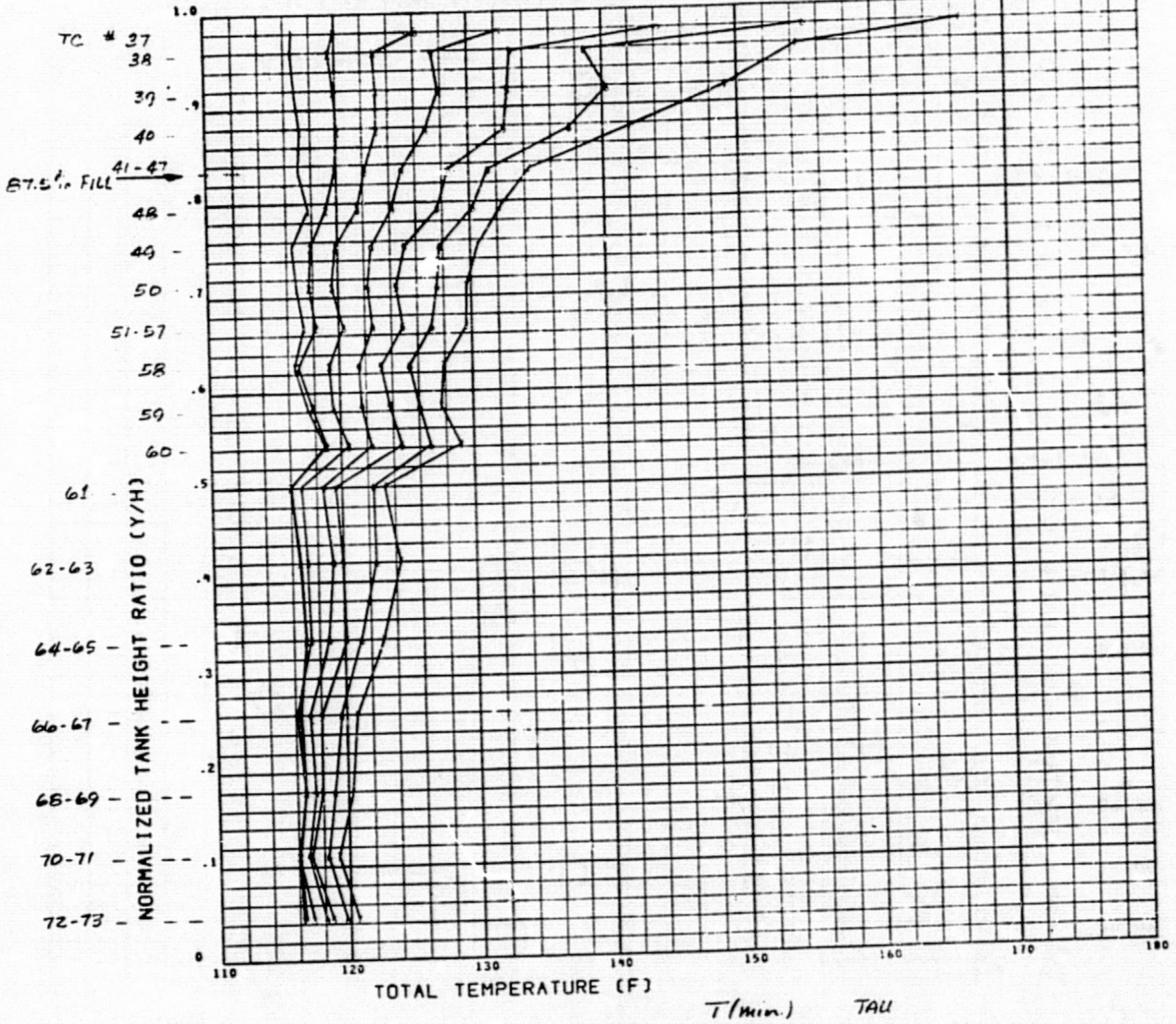


$q''_H = 1000$ BTU/hr ft^2 LIQ + ULGE HTG

	T(Min)	τ(TAU)
1	0.	0.
2	.333	.167
3	1.	.5
4	1.667	.833
5	2.	1.000

FIGURE 5.2-1b

6 IN. TNK TST8G11S STRAT TEMPERATURE PROFILE

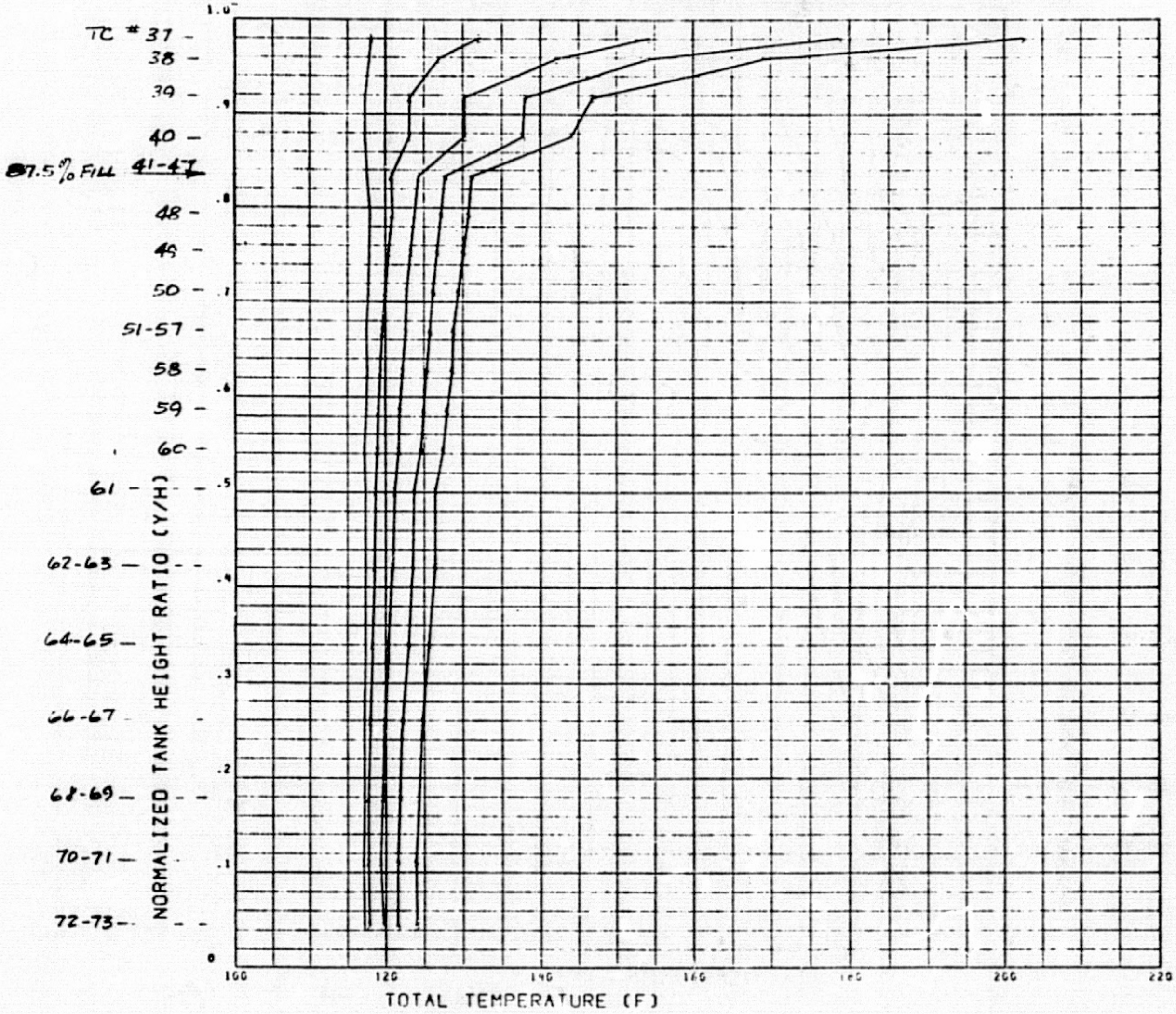


	T(min.)	TAU
1	0.	0.
2	.333	.167
3	.667	.334
4	1.000	.5
5	1.333	.666
6	1.667	.834
7	2.000	1.000

q''_H = 1000 BTU/hr ft^2

LIQUID+ ULLAGE HT'G

FIGURE 5.2-1c
12 IN. TNK TEST 1GΣ31 – STRAT TEMPERATURE PROFILE



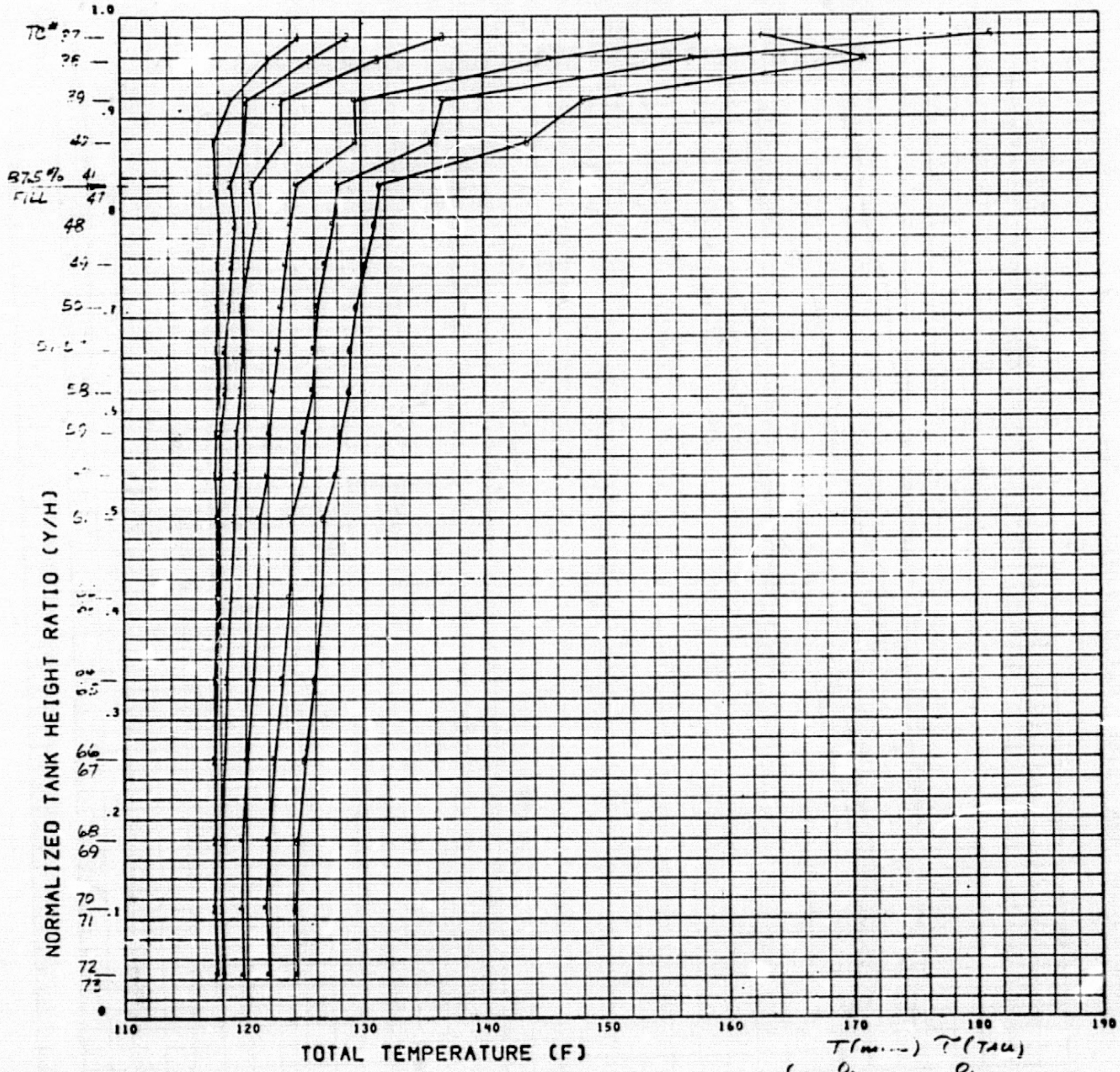
q''_H = 500 BTU/hr ft^2

LIQ + ULLAGE HT'G

	T(min)	τ (TAU)
1	0.	0.
2	2.	.25
3	4.	.50
4	6.	.75
5	8.	1.0

FIGURE 5.2-1d

12 IN. TNK TST1G17 STRAT TEMPERATURE PROFILE



$\dot{q}''_{H}$ = 500 BTU/hr ft² LIQ + ULGE HTG

	T(min)	τ(TAU)
1	0.	0.
2	1.	.125
3	2.	.25
4	4.	.5
5	6.	.75
6	8.	1.00

FIGURE 5.2-2a

6 IN. TNK TEST 8GΣ3 – STRAT DEL – TEMP PROFILE

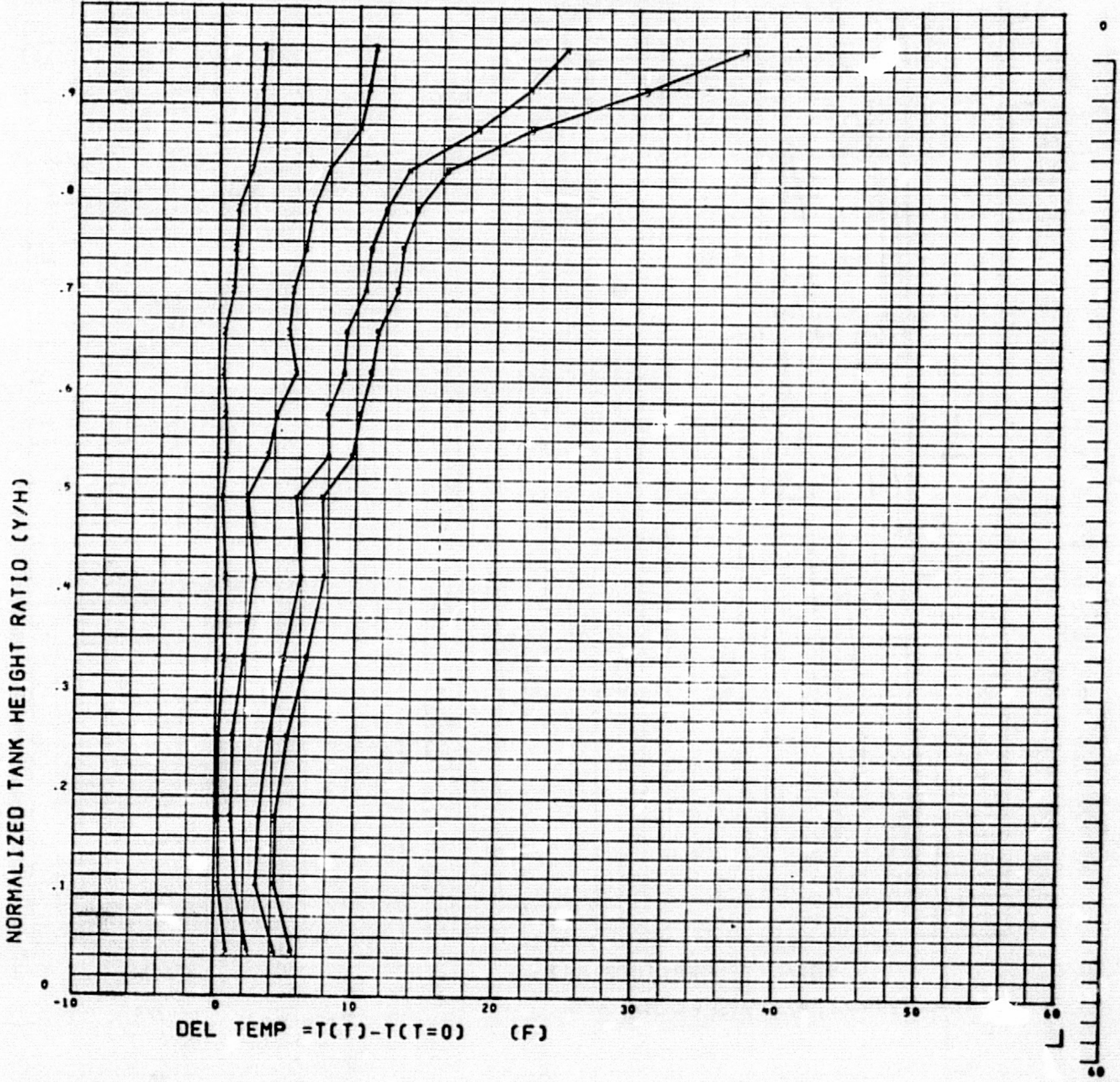


FIGURE 5.2-2b

6 IN. TNK TST8G11S STRAT DEL – TEMP PROFILE

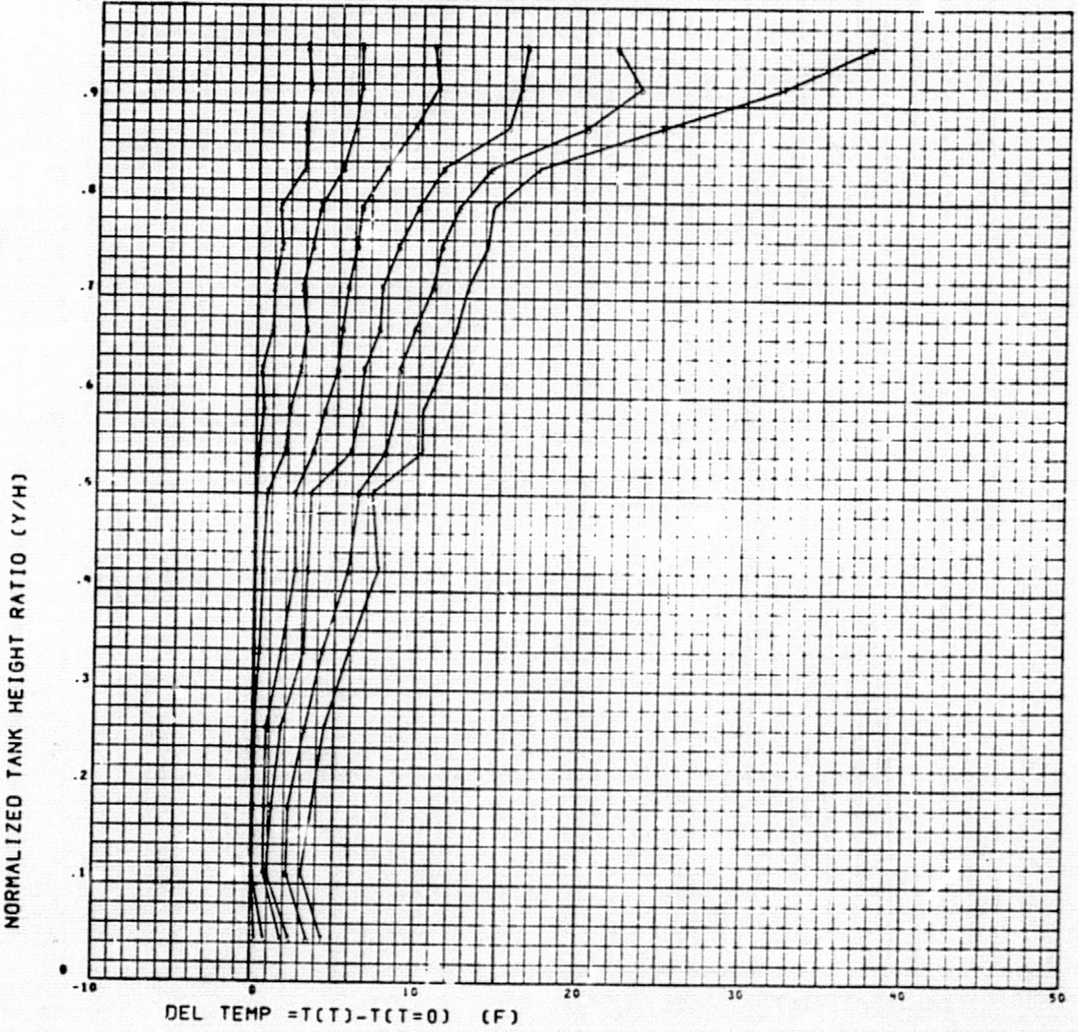


FIGURE 5.2-2c
12 IN. TNK TEST 1GΣ31 – STRAT DEL – TEMP PROFILE

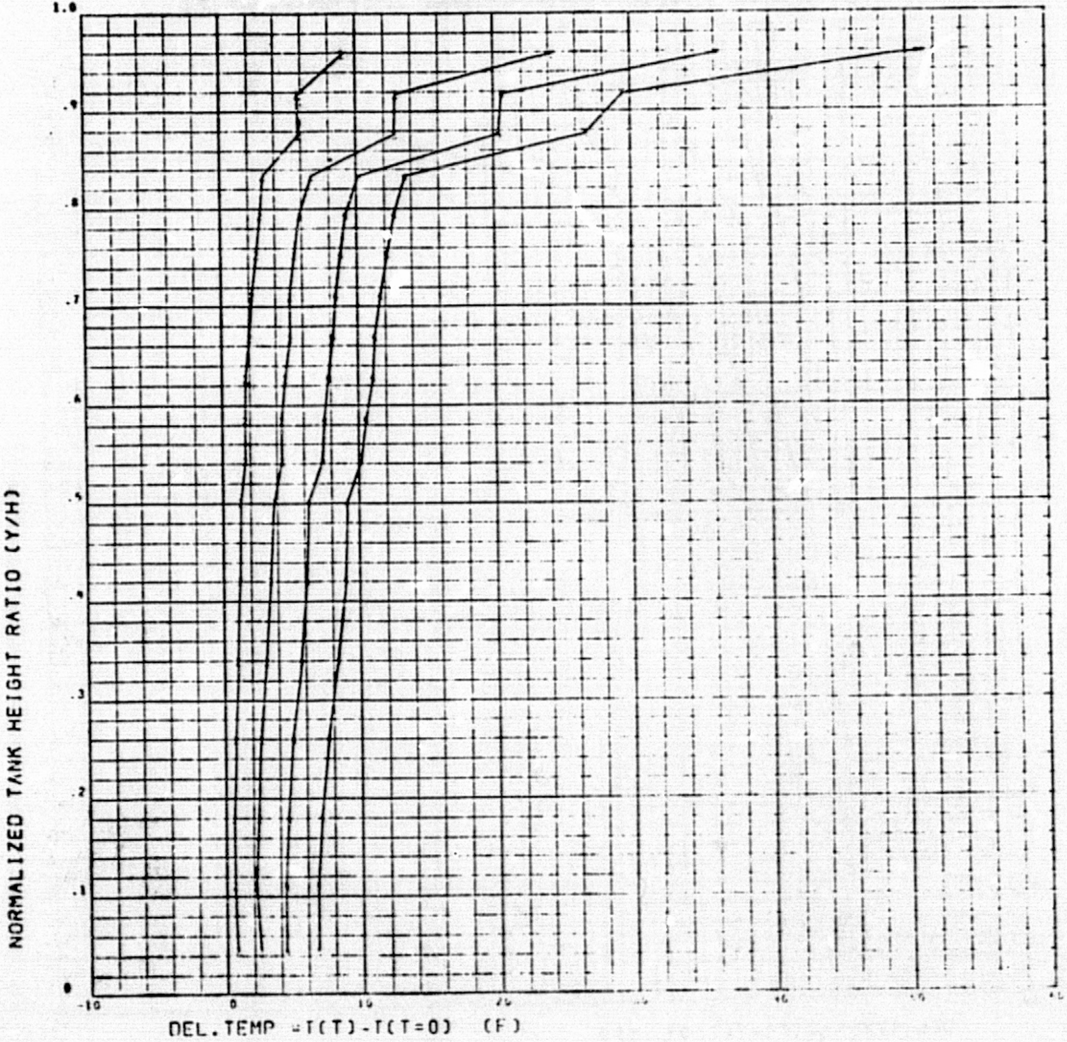


FIGURE 5.2-2d

12 IN. TNK TST1G17 STRAT DEL – TEMP PROFILE

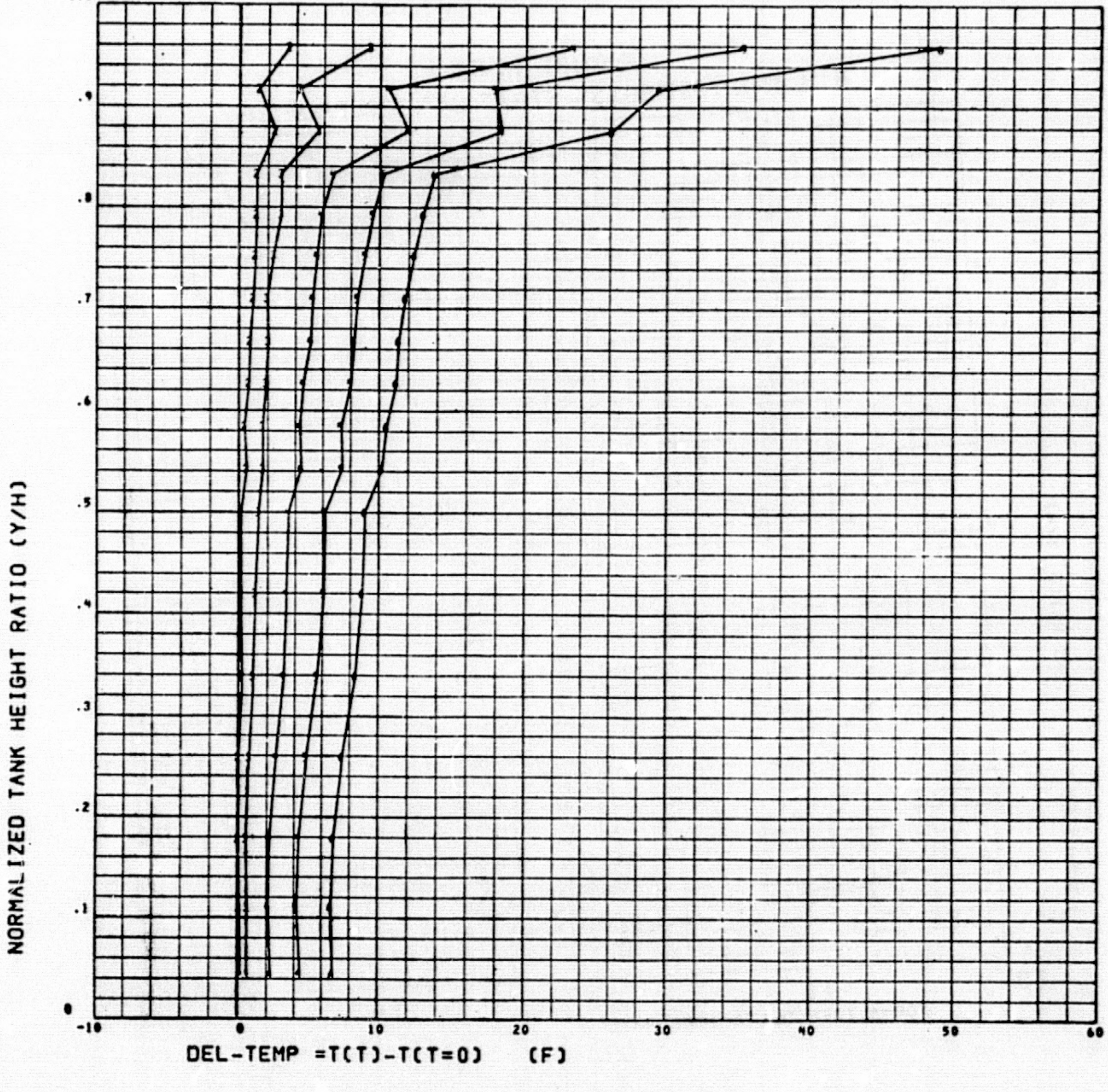


FIGURE 5.2-3a

6 IN. TNK TEST 8GΣ3 – STRAT DTNORM PROFILE

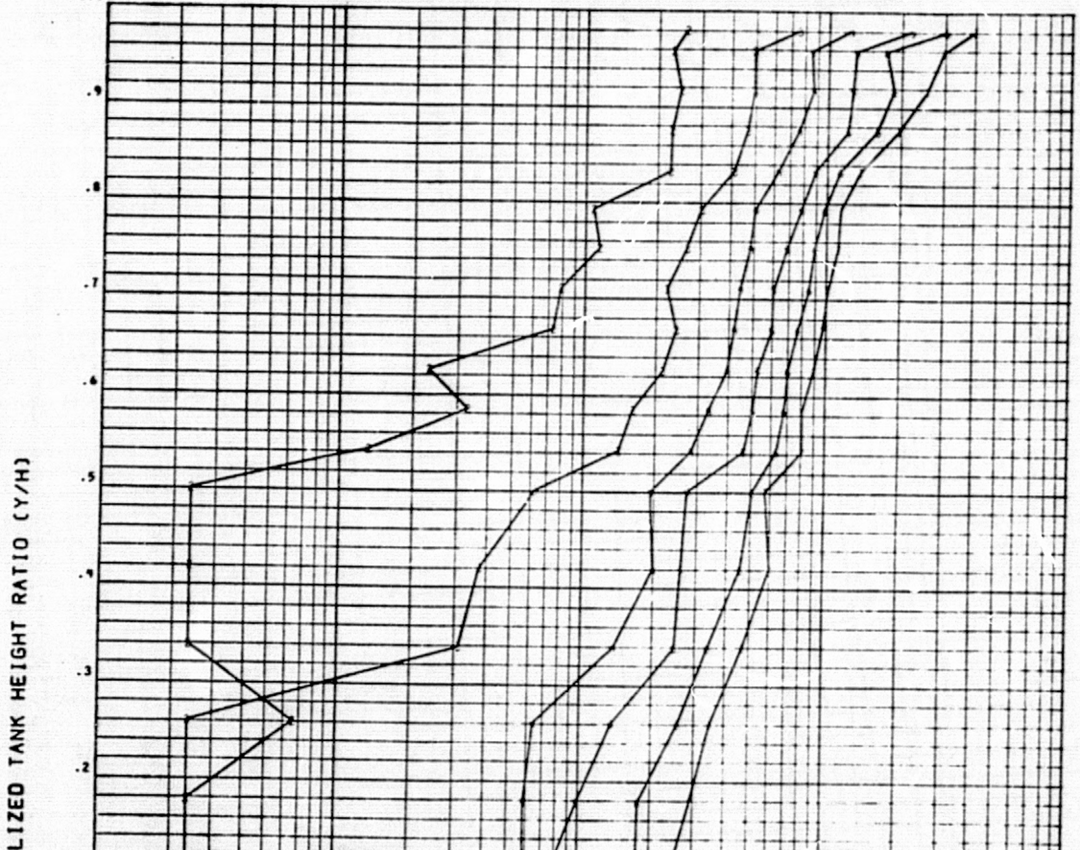


FIGURE 5.2-3b
6 IN. TNK TST8G11S STRAT DTNORM PROFILE

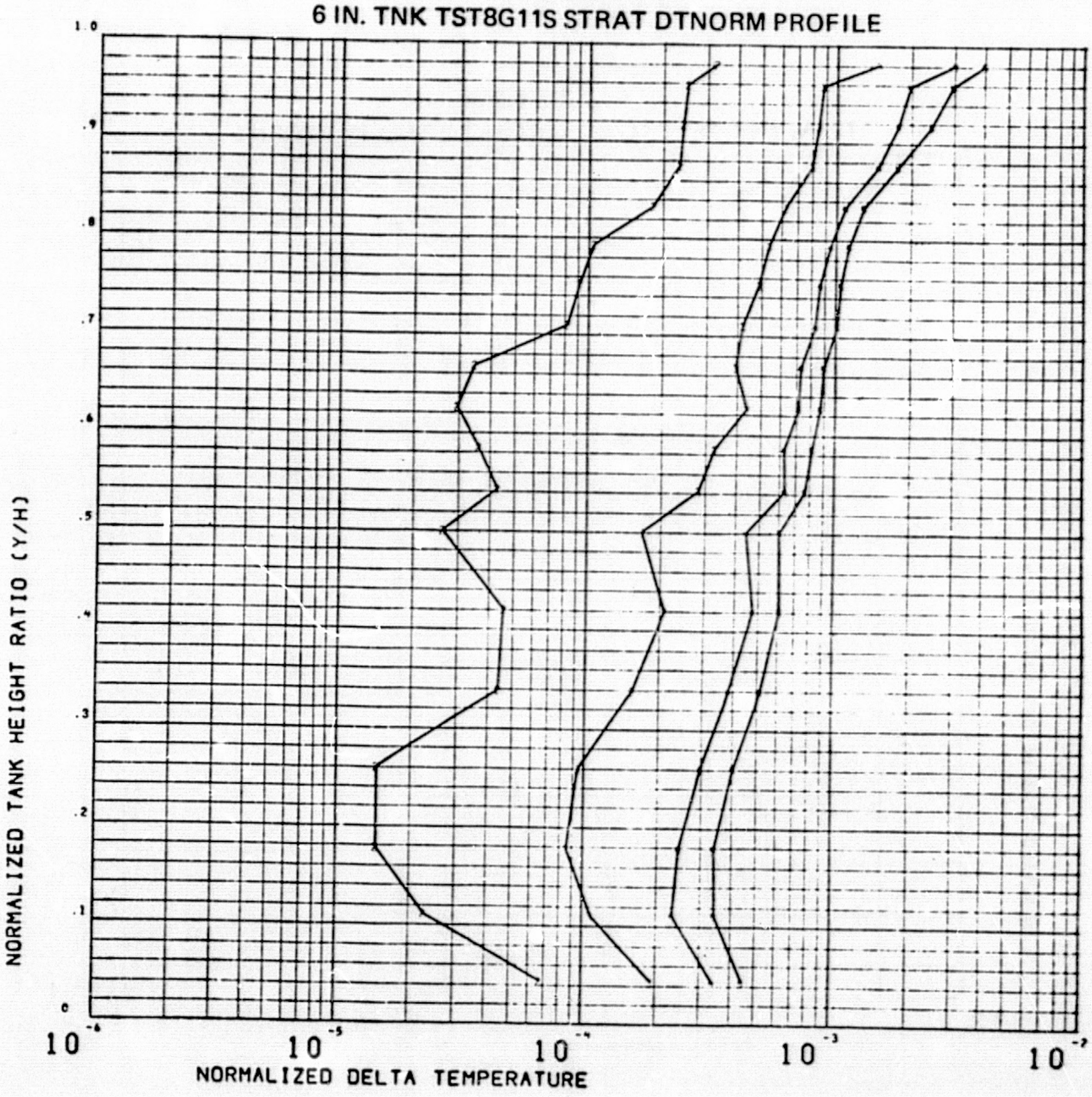


FIGURE 5.2-3c
12 IN. TNK TEST 1GΣ31 – STRAT DTNORM PROFILE

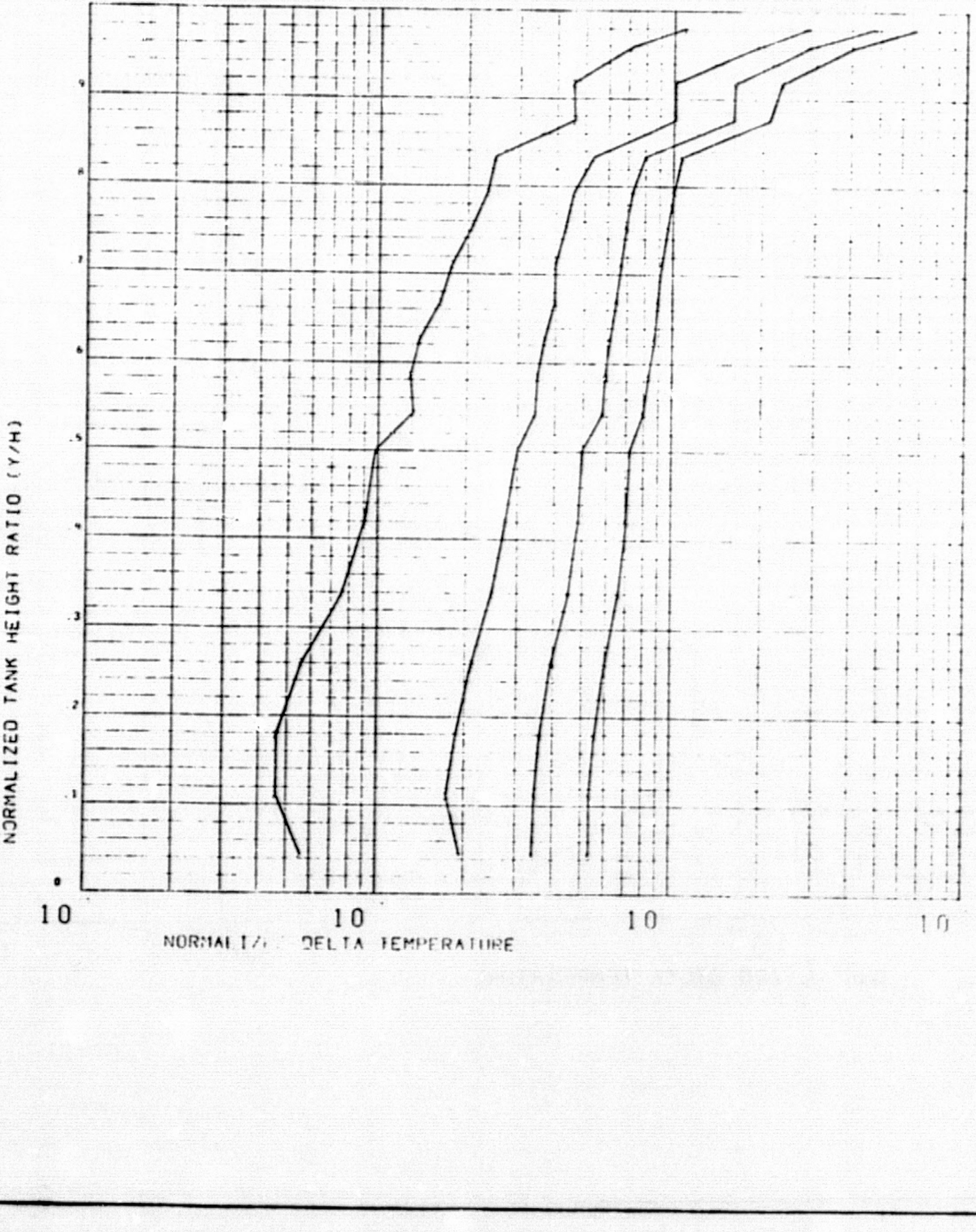


FIGURE 5.2-3d
12 IN. TNK TST1G17 STRAT DTNORM PROFILE

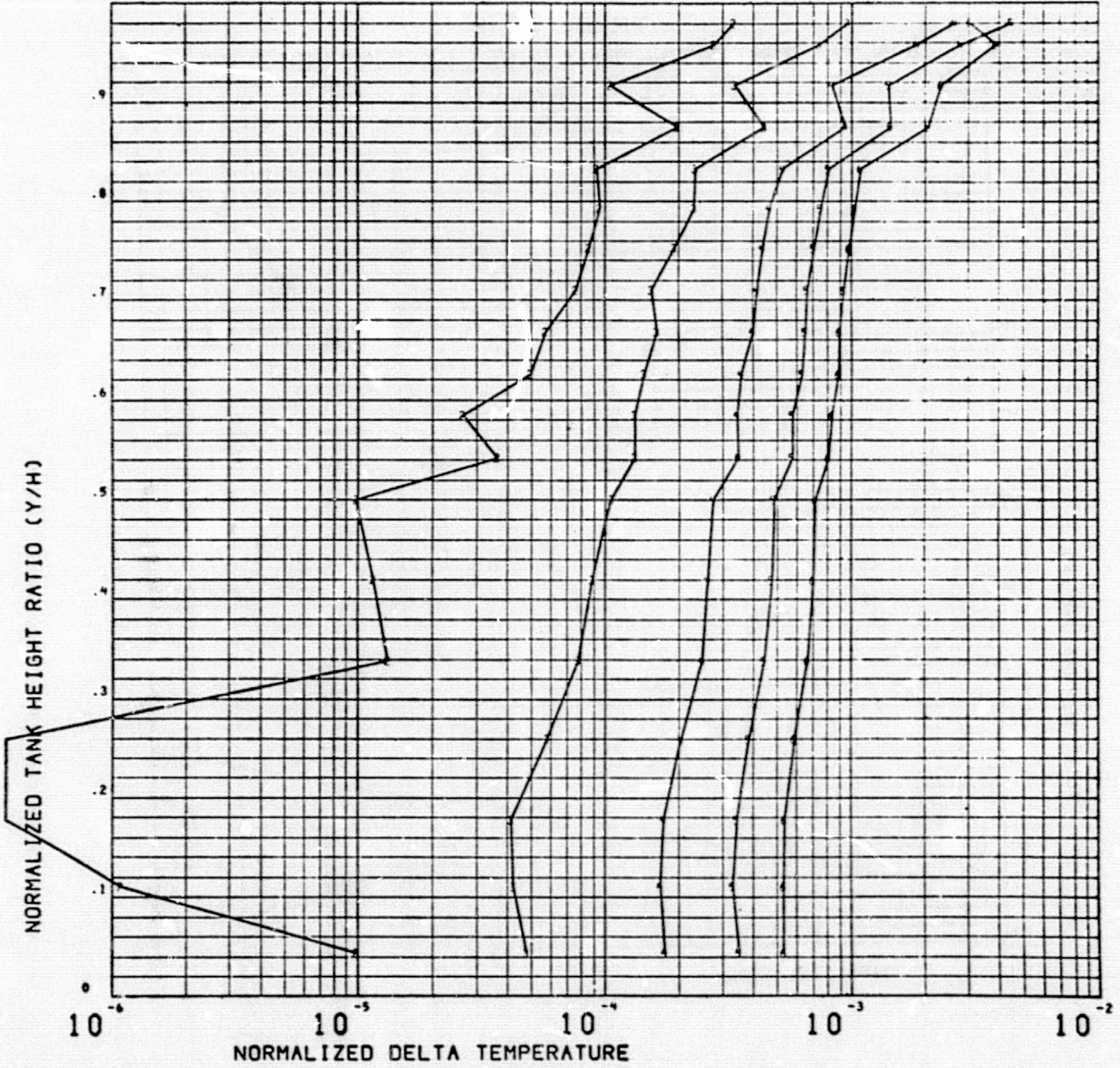


FIGURE 5.2-4a

6 IN. TNK TEST 8GΣ3 – BULK ULGE γ LIQ TEMP HISTORIES

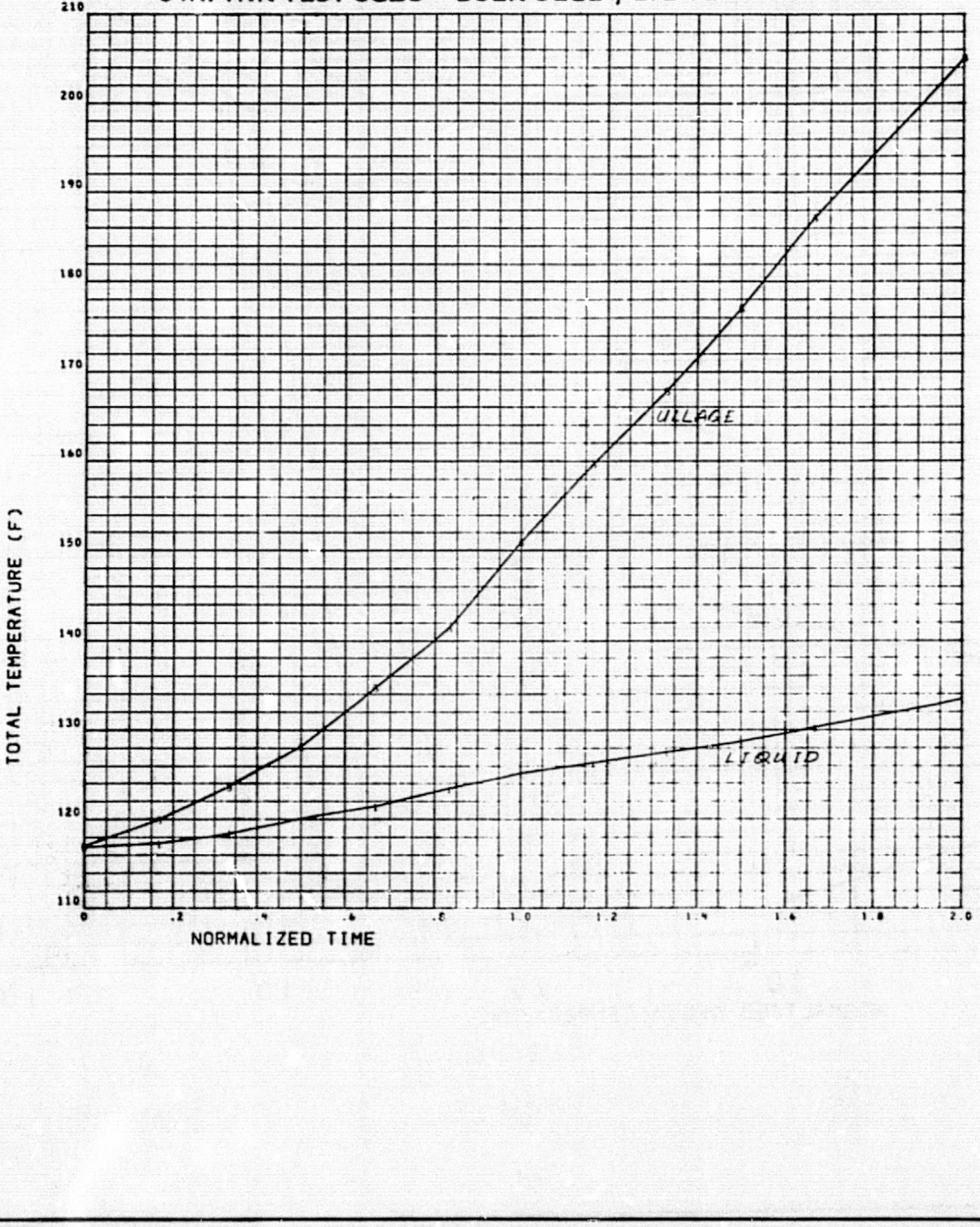
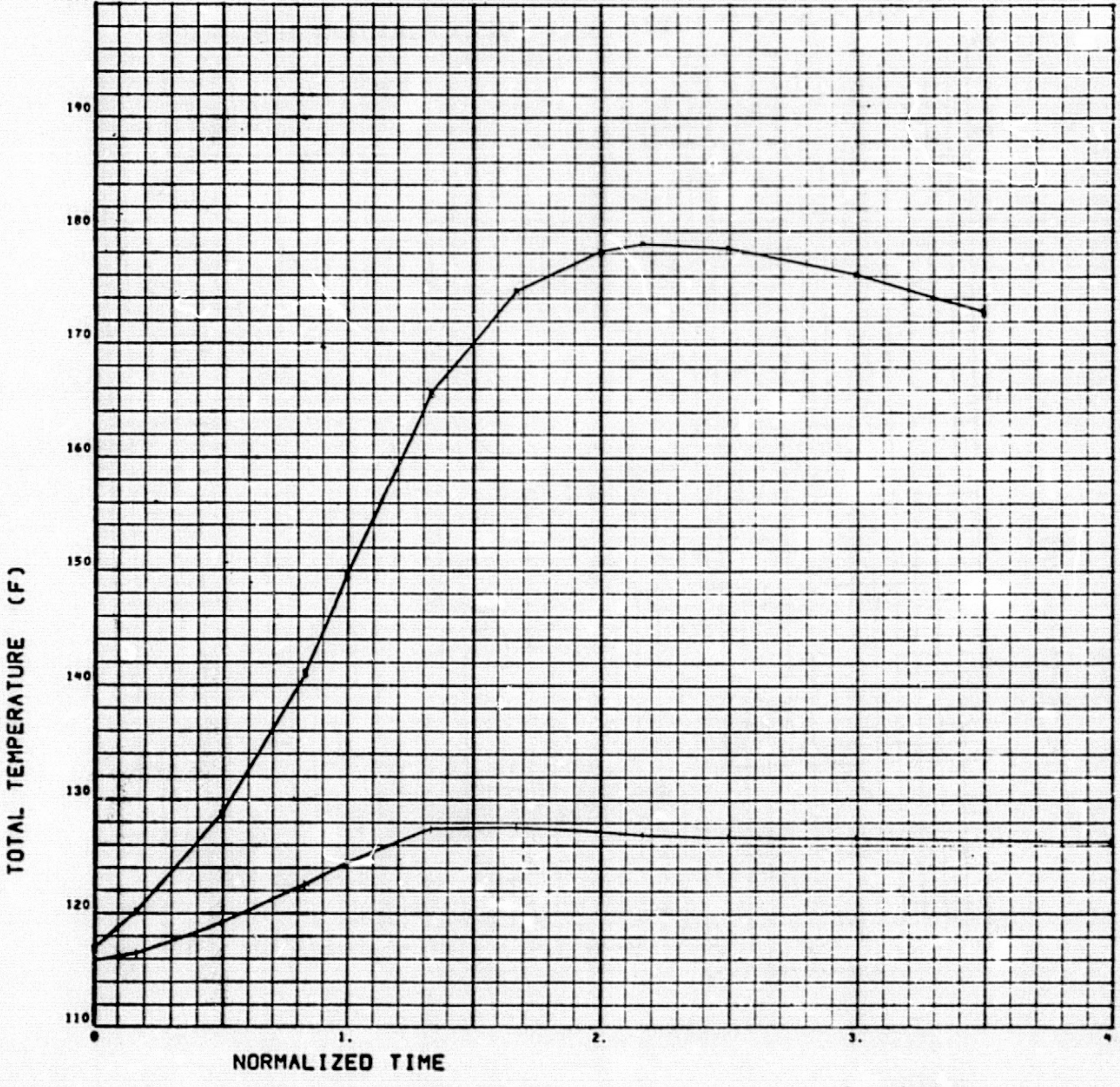


FIGURE 5.2-4b
6 IN. TNK TST8G11S BULK ULGE /LIQ TEMP HISTORIES



B - ULLAGE
L - LIQUID

FIGURE 5.2-4c

12 IN. TNK TEST 1GΣ31 – BULK ULGE γLIQ TEMP HISTORIES

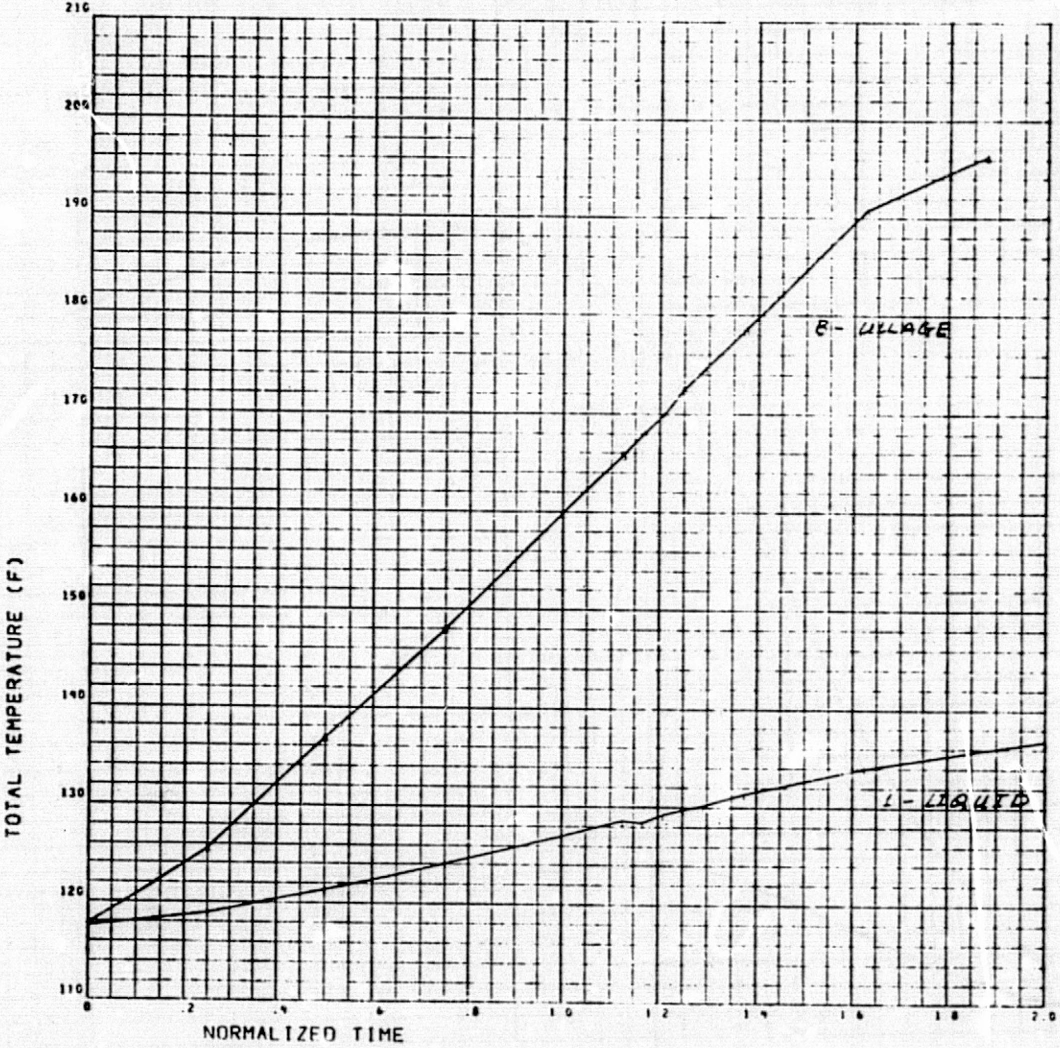


FIGURE 5.2-4d

12 IN. TNK TST1G17 BULK ULGE γ LIQ TEMP HISTORIES

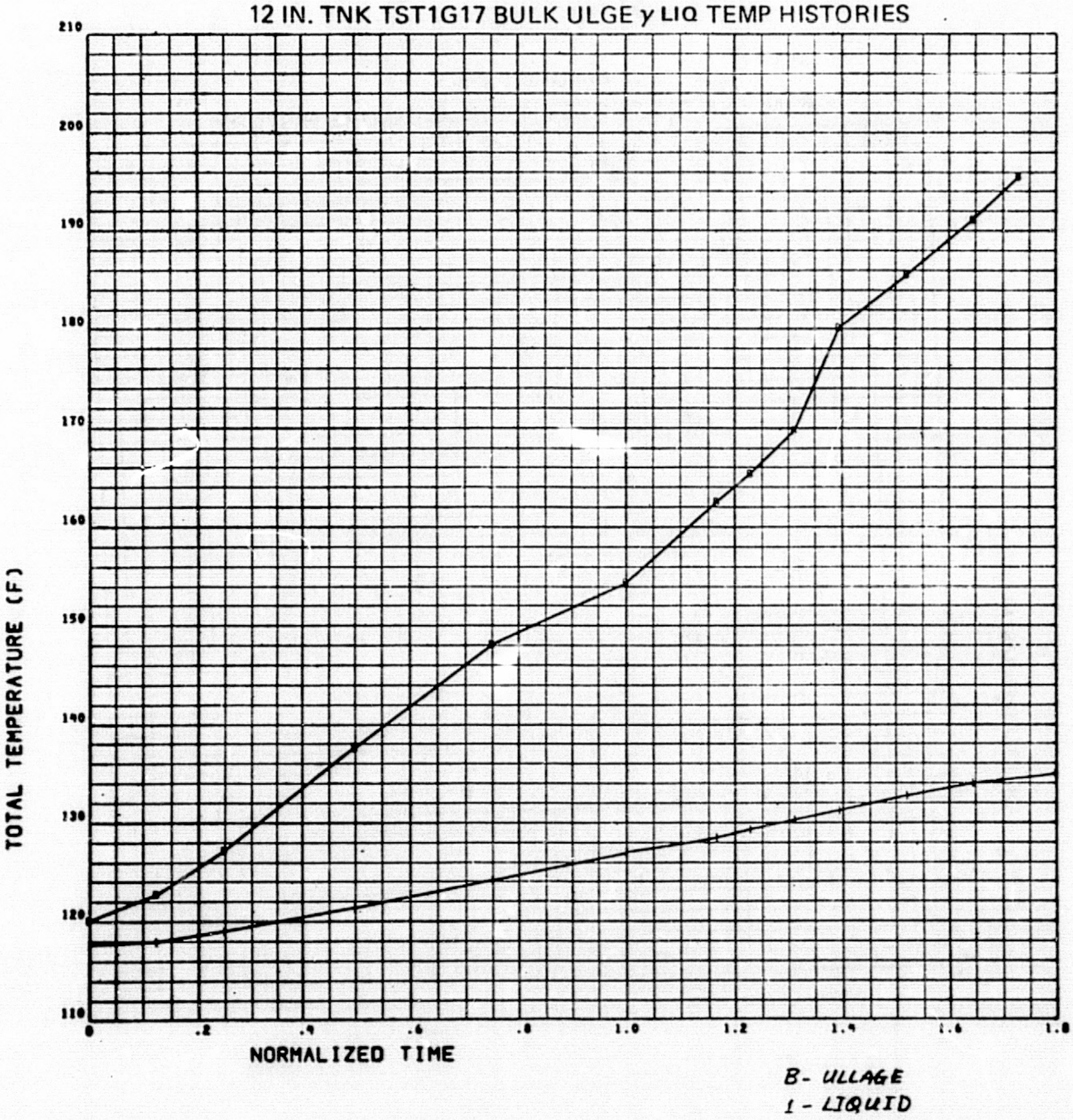


FIGURE 5.2-5a

6 IN. TNK TEST 8GΣ3 – TANK PRESSURE HISTORY

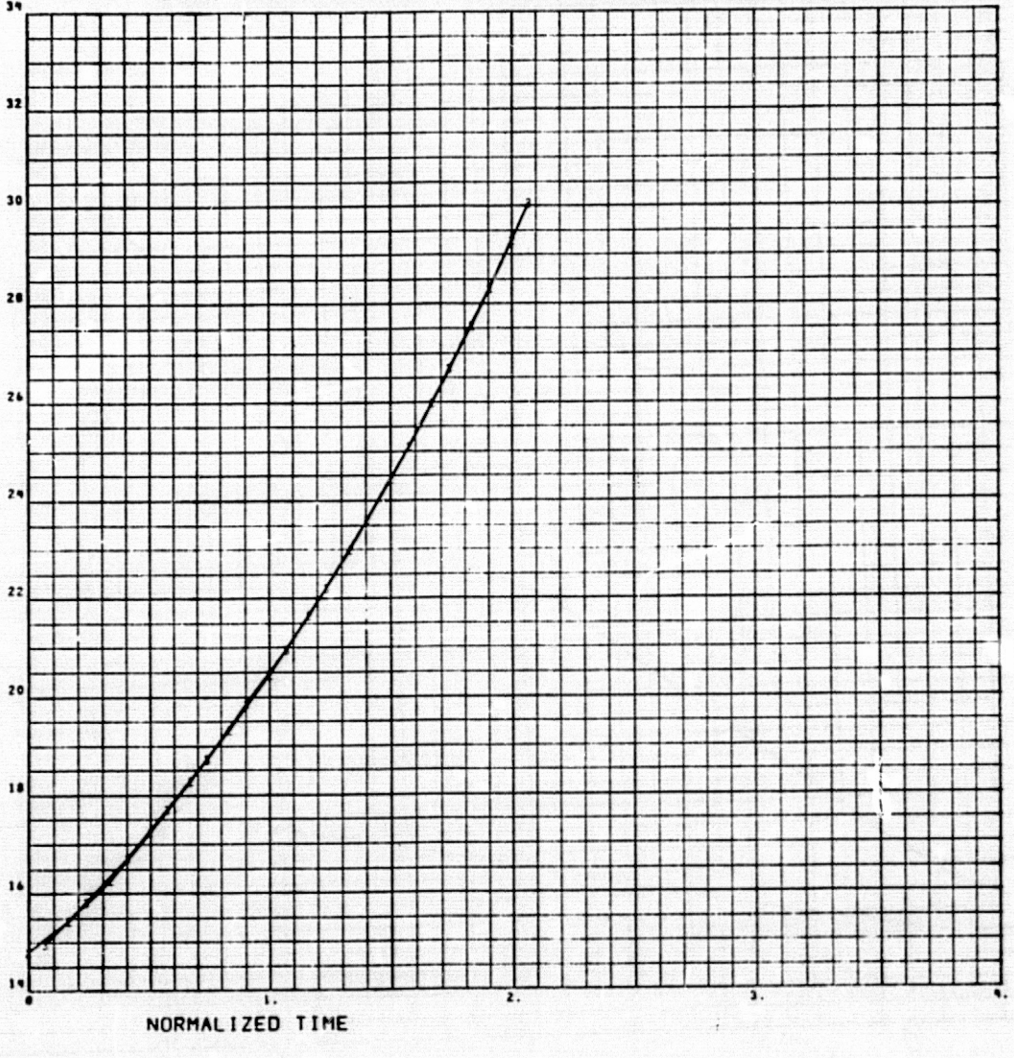
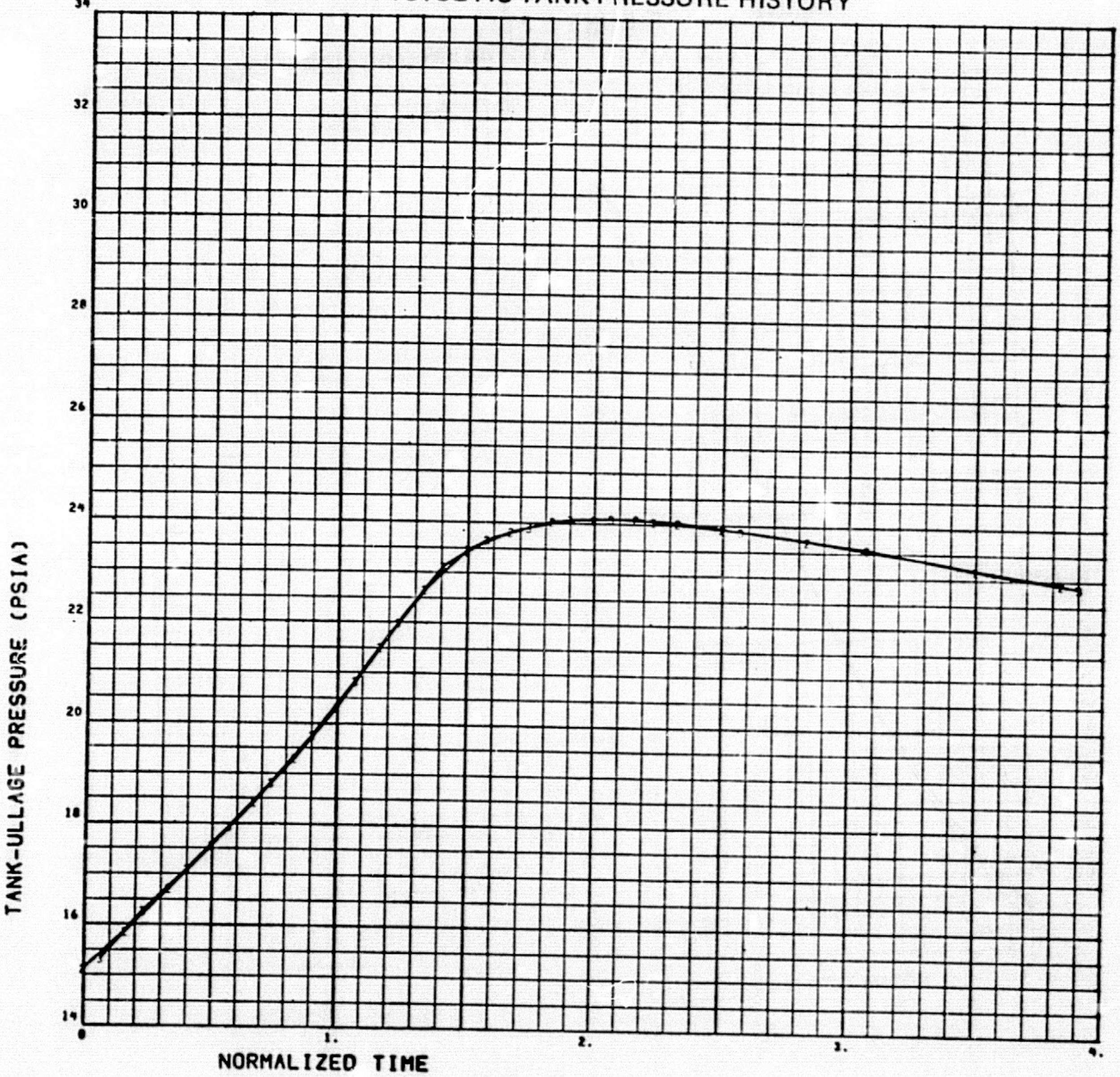
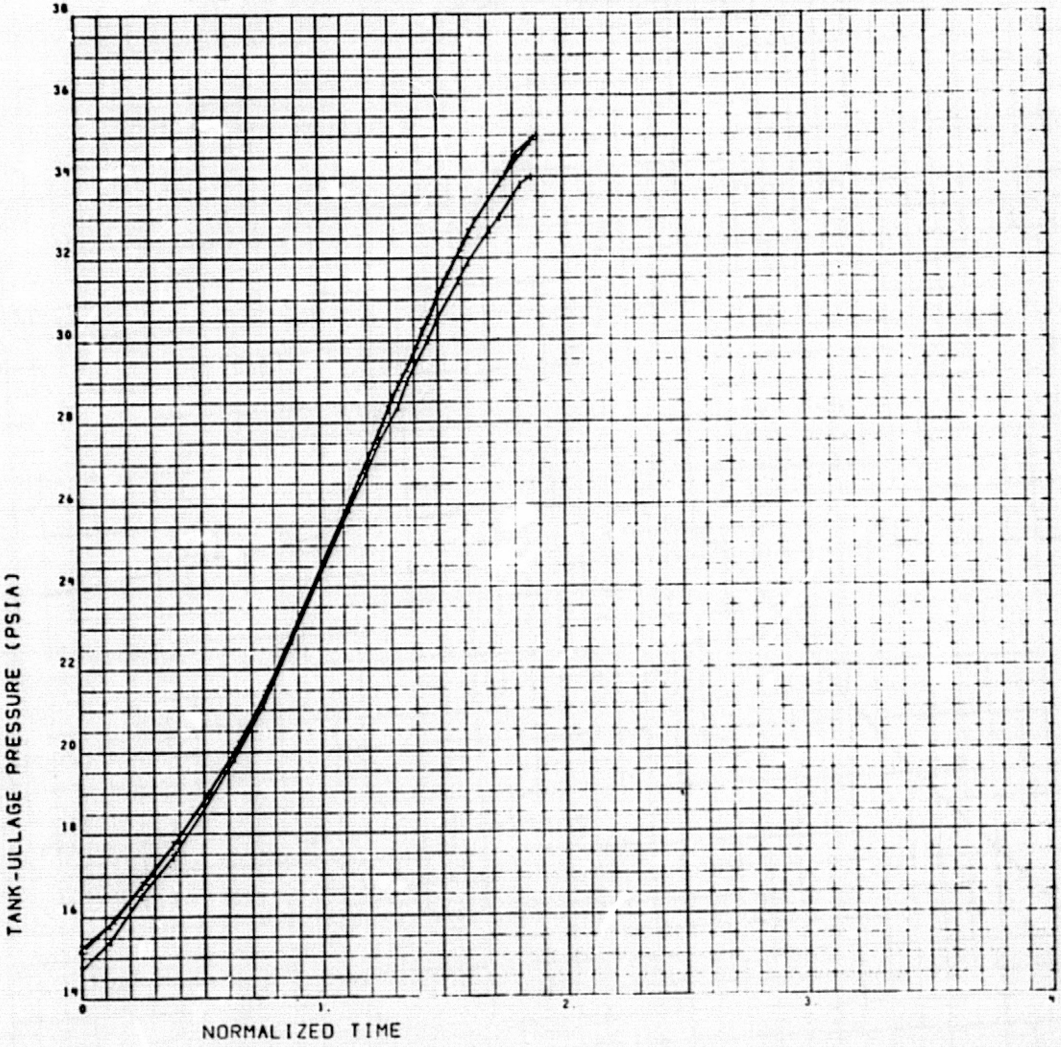


FIGURE 5.2-5b
6 IN. TNK TST8G11S TANK PRESSURE HISTORY



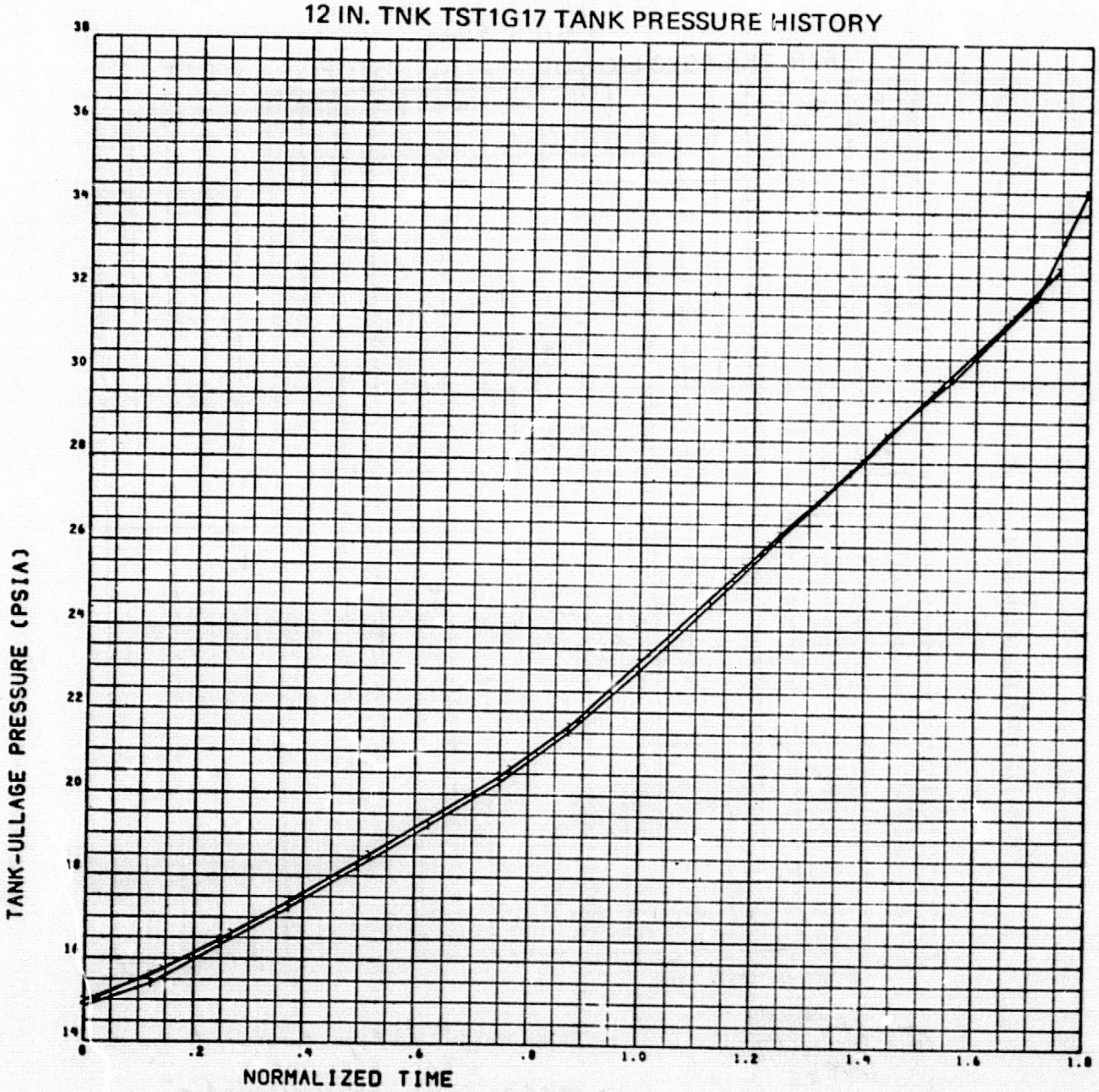
2, 3 - Transducer Measured

FIGURE 5.2-5c
12 IN. TNK TEST 1GΣ31 – TANK PRESSURE HISTORY



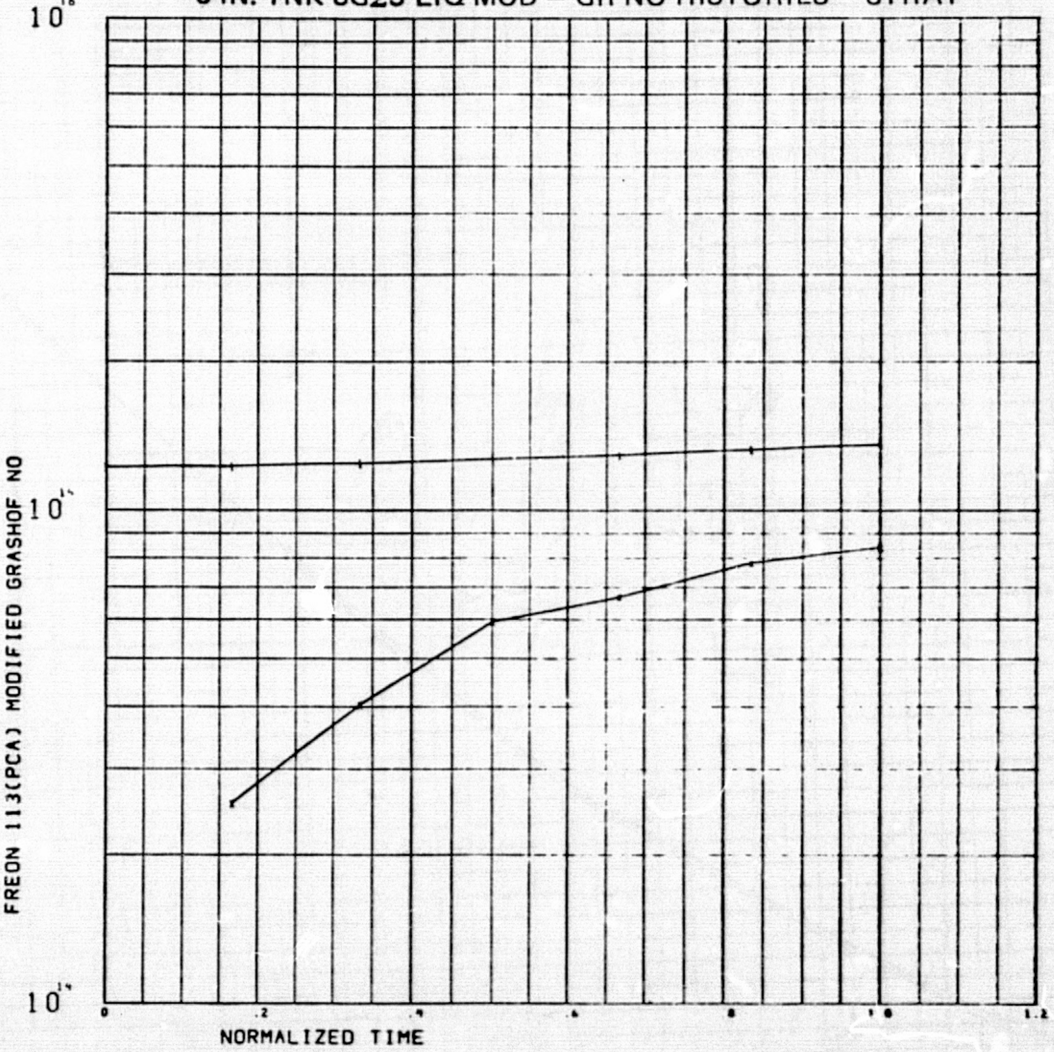
1 - Gage
2 } - Transducer
3 }

FIGURE 5.2-5d
12 IN. TNK TST1G17 TANK PRESSURE HISTORY



1 - Gage measured
2, 3 - Transducer measured

FIGURE 5.2-6a
6 IN. TNK 8GΣ3 LIQ MOD – GR NO HISTORIES – STRAT



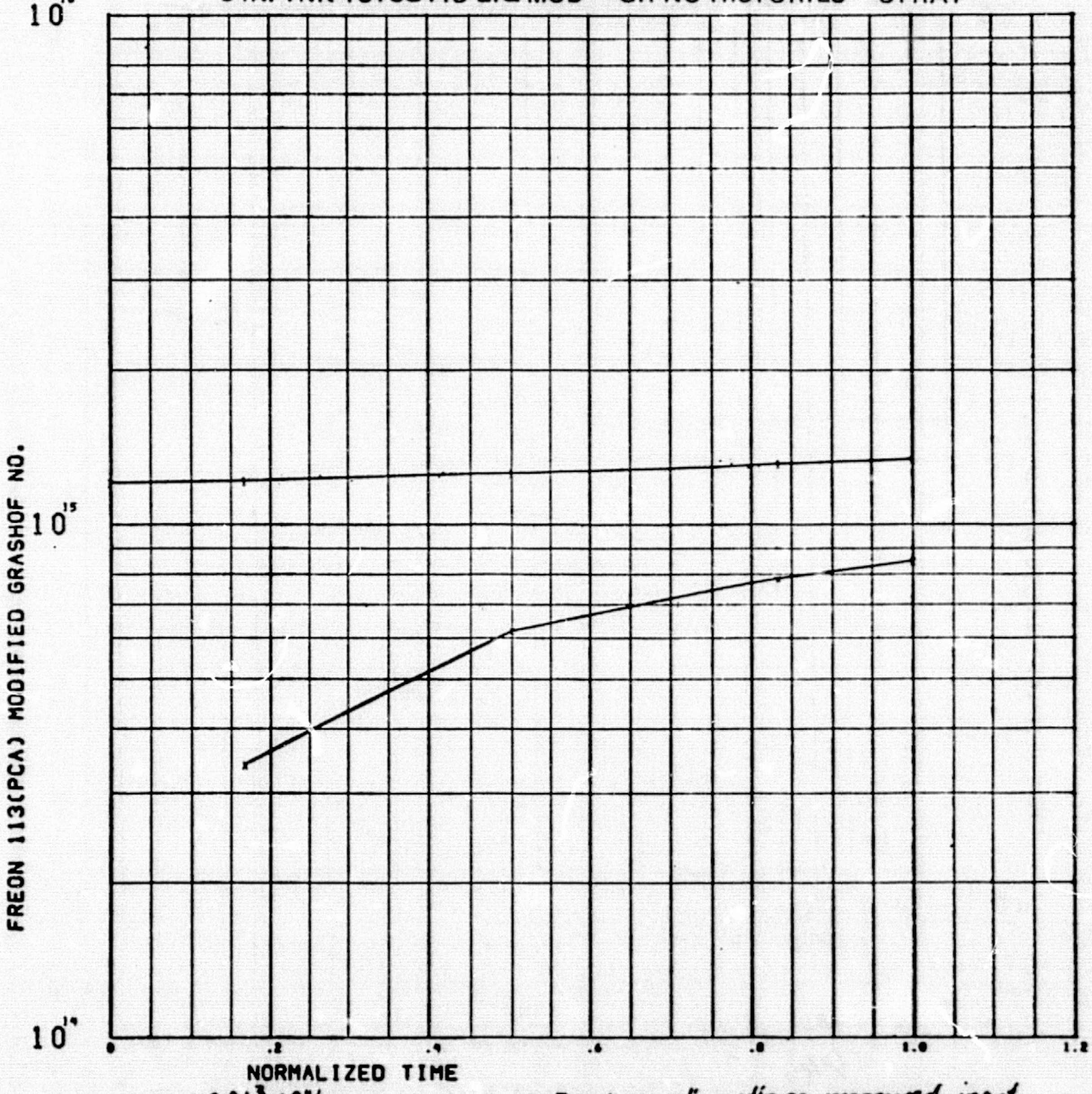
$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$

L = Liquid depth

1 - Based on q''_{UH} ullage measured input

x - Based on experimentall absorbed q''_{liquid}

FIGURE 5.2-6b
6 IN. TNK TST8G11S LIQ MOD – GR NO HISTORIES – STRAT



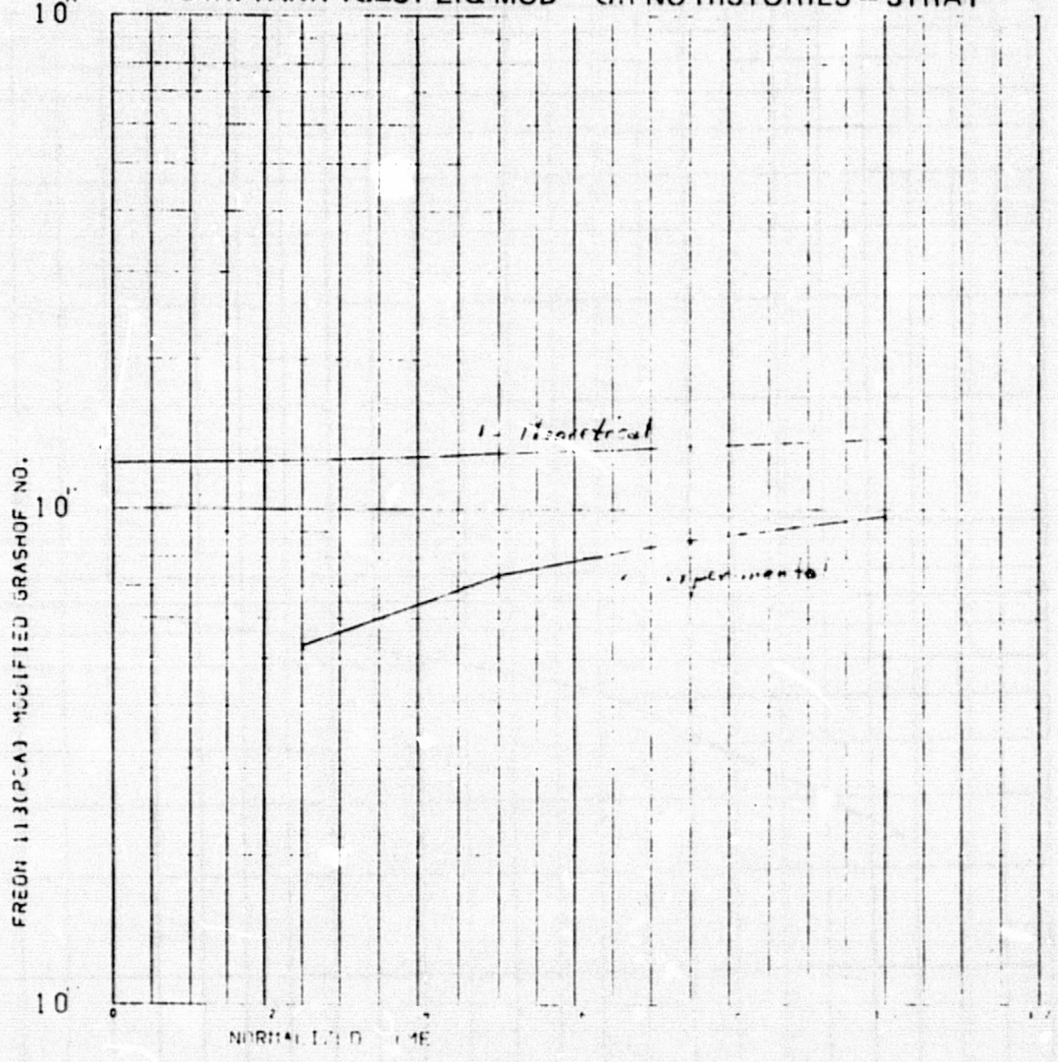
$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''_{in} L}{k}\right)$

L = Fluid depth

I - Based on q''_{in} wattage measured input

X - Based on experimentally absorbed q''_{fluid}.

FIGURE 5.2 6c
12 IN. TANK 1GΣ31 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

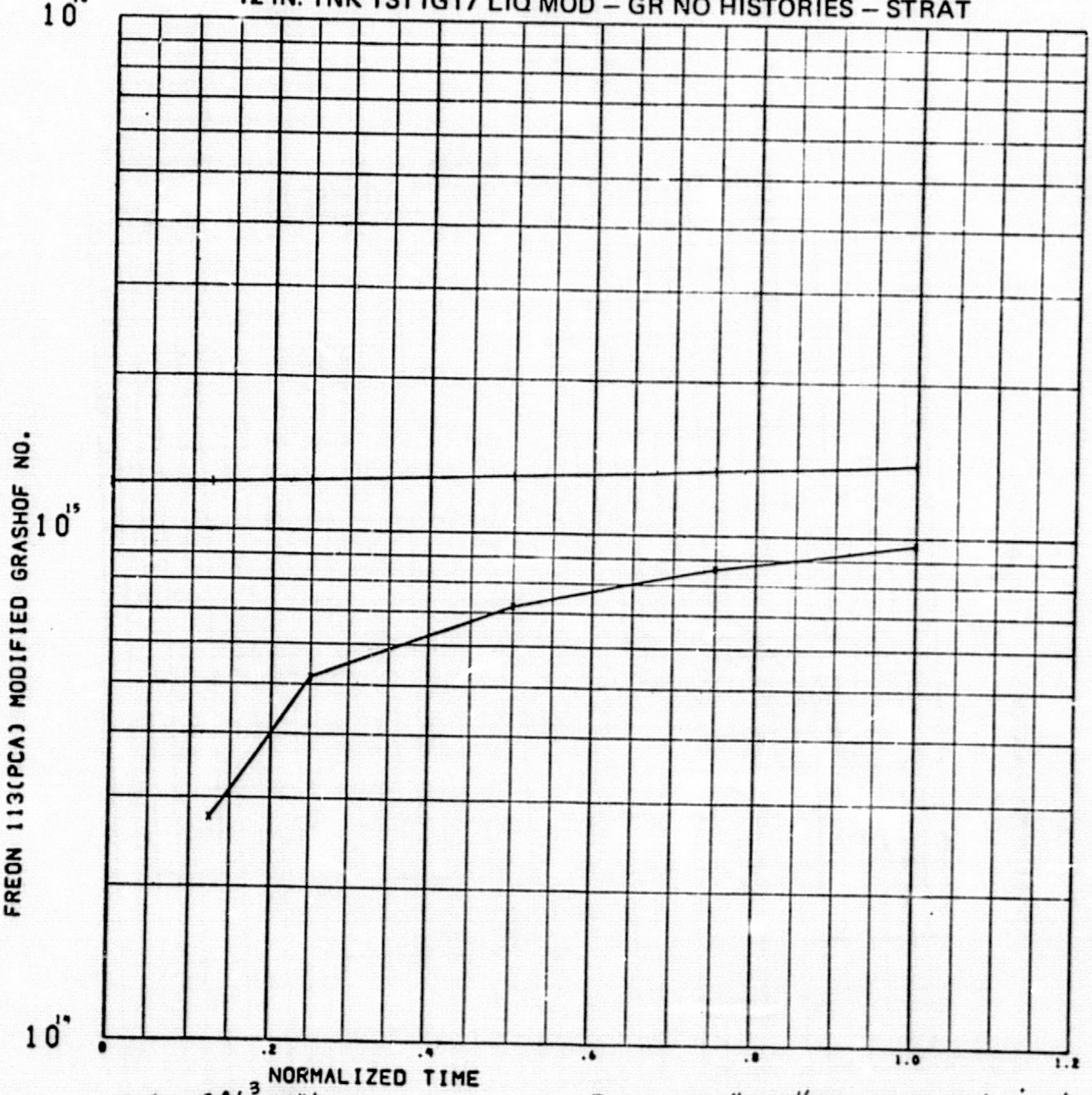
L = Fluid depth

1 = Based on q''_H wattage measured input

2 = Based on experimentally determined q''_{fluid}

FIGURE 5.2-6d

12 IN. TNK TST1G17 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^{*} = \frac{g\beta L^{3}}{(\mu/\rho)_{l}^{2}}\left(\frac{q''_{\delta}L}{k}\right)$$

L = Fluid depth

1 - Based on $q''_{\delta H}$ wattage measured input

x - Based on experimentally absorbed $q''_{\delta fluid}$

FIGURE 5.2-7a

6 IN. TNK 8GΣ3 LIQ FOURIER NO HISTORY

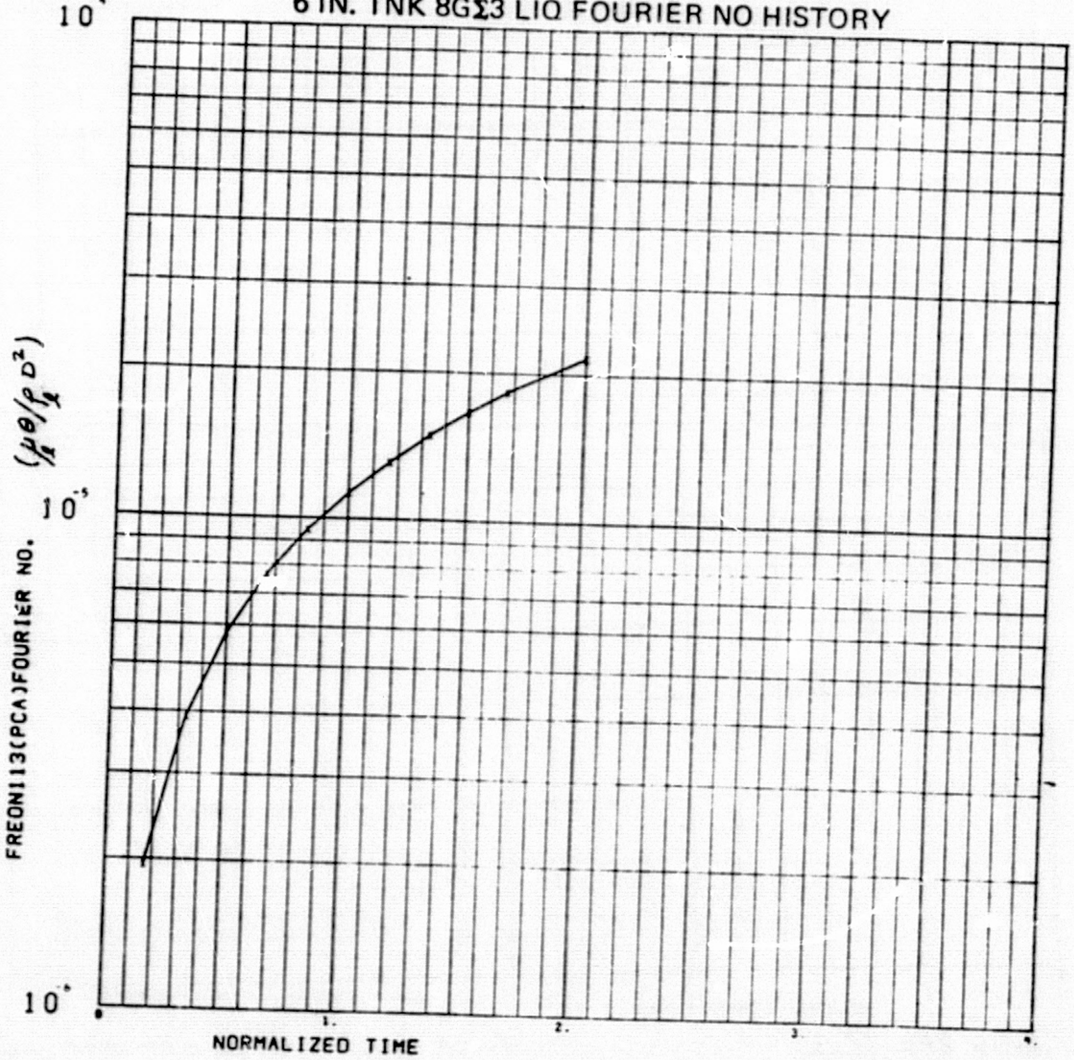


FIGURE 5.2-7b

6 IN. TNK 8G11S LIQ FOURIER NO HISTORY

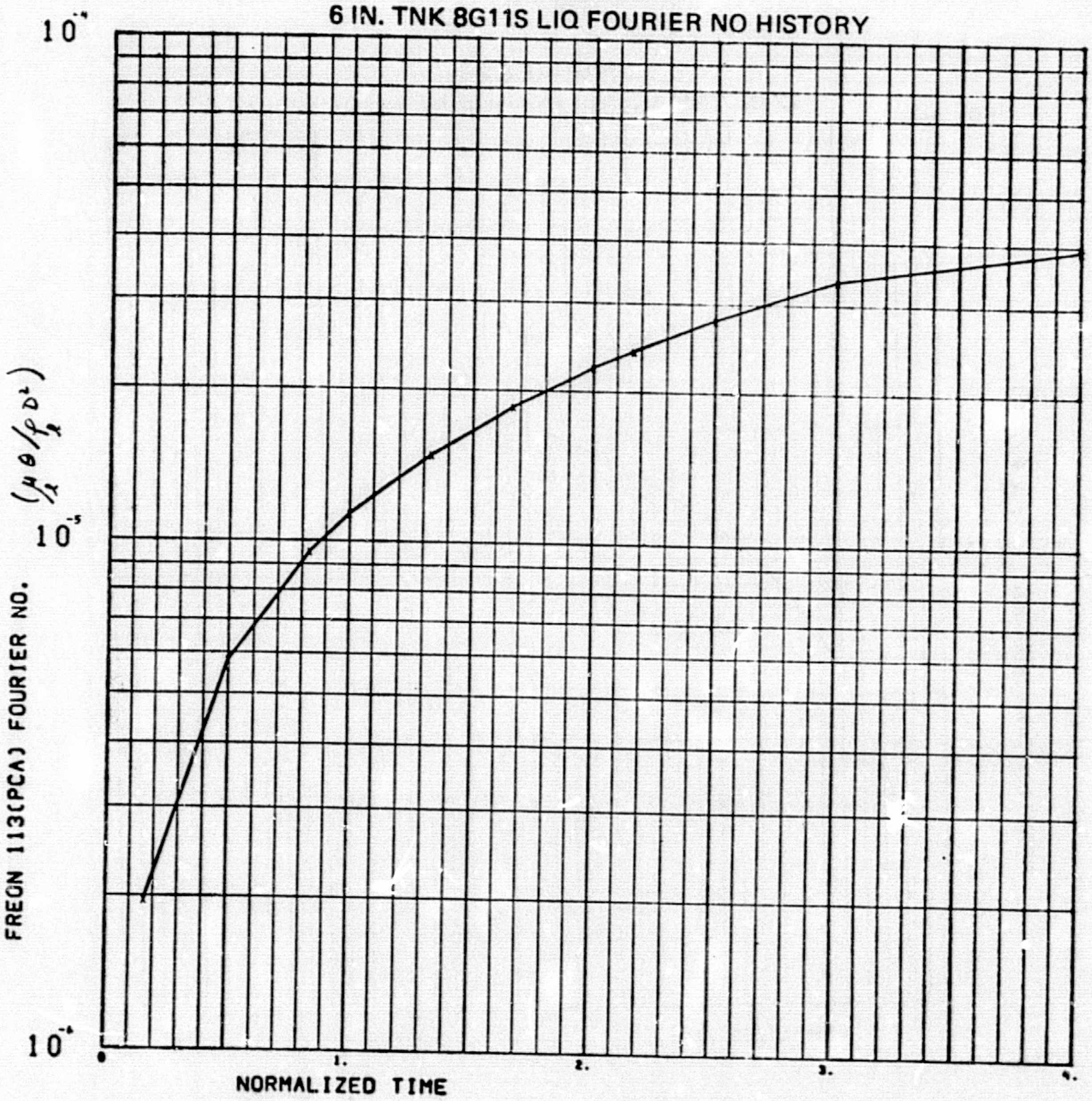


FIGURE 5.2-7c
12 IN. TNK 1GΣ31 LIQ FOURIER NO HISTORY

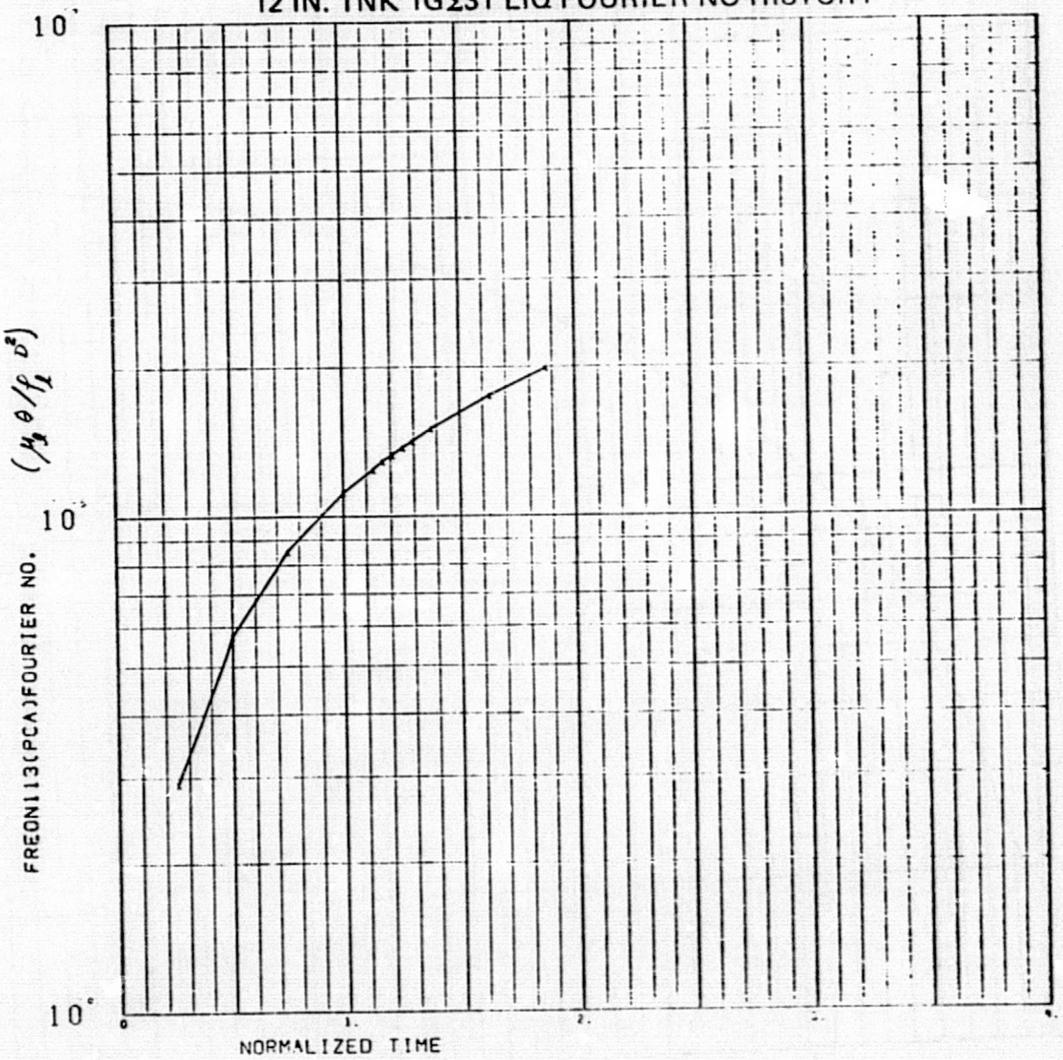
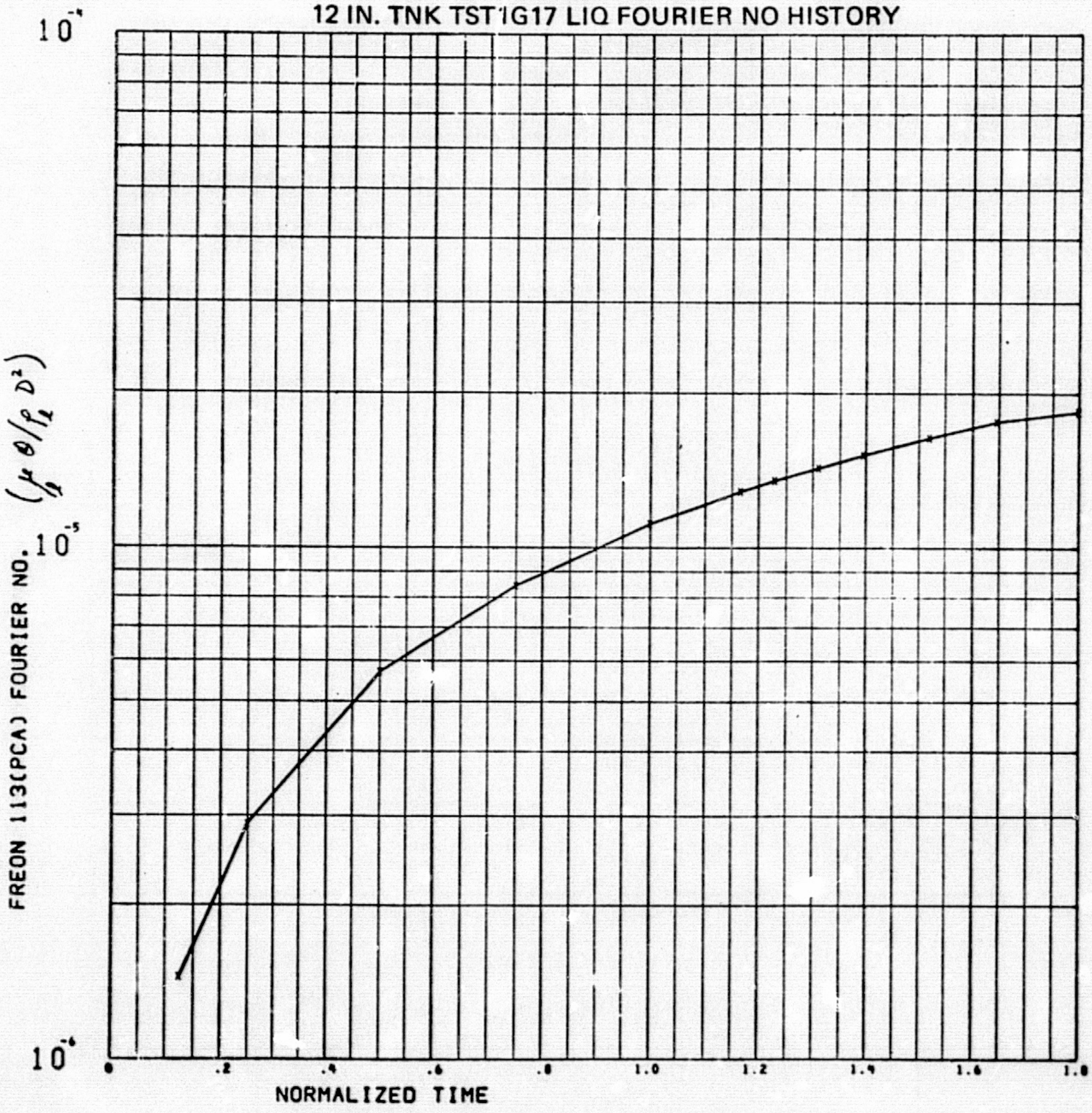


FIGURE 5.2-7d

12 IN. TNK TST1G17 LIQ FOURIER NO HISTORY



Section 5.3

SCALING SET

6-in.-Dia Tank Tests	12-in. -Dia Tank Tests
8G	1G
Test #9S Test #15S	Test #33 Test #32

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Table 5.3-1a. 6 IN. DIA. TANK TEST 8G#9S (Page 1 of 2)

```
        STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


  DOME AREA FT2=   .3927      CYL AREA FT2=  1.5708       FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131      1/2 CYL WALL VOLFT3=   .00164     FLNGE VOL FT3=    .00076
DME MASS LBM=   .65596     MASS 1/2 CYL LBM=    .81996     FLANGE MASS=   .38058

 LIQ VOL FT3=   .13090      ULLAGE VOL FT3=   .13090

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56= 701.5691   H910= 701.5691   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 701.5691
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=   45.913      (STRAT+DESTRAT)BTU=    0.000
EST.LIQ TEMP INCRSE(STRAT)=   16.4923F     (STRAT+DESTRAT)=    0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000     (STRAT+DESTRAT)BTU=    0.000
```

Table 5.3-1b. 6 IN. DIA. TANK TEST 8G#15S

```
        STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


  DOME AREA FT2=   .3927      CYL AREA FT2=  1.5708       FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131      1/2 CYL WALL VOLFT3=   .00164     FLNGE VOL FT3=    .00076
DME MASS LBM=   .65596     MASS 1/2 CYL LBM=    .81996     FLANGE MASS=   .38058

 LIQ VOL FT3=   .13090      ULLAGE VOL FT3=   .13090

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56= 701.5691   H910= 701.5691   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 701.5691
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=   45.917      (STRAT+DESTRAT)BTU=    0.000
EST.LIQ TEMP INCRSE(STRAT)=   16.4901F     (STRAT+DESTRAT)=    0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000     (STRAT+DESTRAT)BTU=    0.000
```

Table 5.3-1c. 12 IN. DIA. TANK TEST 1G#33 (Page 2 of 2)

```
       STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1.5708       CYL AREA FT2=  6.2832       FLNGE AREA FT2=   .1458
DME WALL VOL FT3=   .01047      1/2 CYL WALL VOLFT3=   .01309     FLNGE VOL FT3=    .00608
DME MASS LBM=  5.24772      MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

 LIQ VOL FT3=  1.04720       ULLAGE VOL FT3=  1.04720

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56= 349.4822   H910= 350.3504   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 349.7716
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=  357.123      (STRAT+DESTRAT)BTU=  934.014
EST.LIQ TEMP INCRSE(STRAT)=   16.0305F      (STRAT+DESTRAT)=   41.8531F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.3-1d. 12 IN. DIA. TANK TEST 1G#32

```
       STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1.5708       CYL AREA FT2=  6.2832       FLNGE AREA FT2=   .1458
DME WALL VOL FT3=   .01047      1/2 CYL WALL VOLFT3=   .01309     FLNGE VOL FT3=    .00608
DME MASS LBM=  5.24772      MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

 LIQ VOL FT3=  1.04720       ULLAGE VOL FT3=  1.04720

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56= 349.4822   H910= 350.3504   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 349.7716
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=  357.123      (STRAT+DESTRAT)BTU=  824.130
EST.LIQ TEMP INCRSE(STRAT)=   16.0304F      (STRAT+DESTRAT)=   36.9441F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.3-2a. 6 IN. DIA TANK TEST 8G #9S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.667	1.333	2.000	2.667	3.333
TAU	0.000	.200	.400	.600	.800	1.000
1	115.625	116.708	118.792	120.875	123.417	125.958
2	116.333	117.292	119.167	121.583	123.917	126.458
3	116.542	117.375	119.583	121.792	124.250	126.625
4	116.708	117.875	119.875	122.208	124.625	127.042
5	116.417	122.833	126.625	129.625	132.583	135.250
6	116.792	125.833	130.542	133.500	135.958	138.792
7	116.917	125.833	129.729	133.229	135.729	138.417
8	117.042	125.833	128.917	132.958	135.500	138.042
9	115.625	119.458	121.667	124.125	126.375	128.500
10	115.917	117.000	118.917	121.375	123.625	126.250
11	116.000	117.375	119.458	121.708	124.042	126.417
12	117.250	130.292	134.417	137.708	140.292	142.750
13	116.625	128.500	130.875	132.875	135.125	137.333
14	115.625	116.708	118.792	120.875	123.417	125.958
15	115.917	117.167	119.125	121.542	123.958	126.458
16	116.250	117.292	119.375	121.708	124.083	126.667
17	116.167	122.917	126.958	129.750	132.292	134.917
18	115.417	122.792	126.250	128.833	131.250	133.333
19	114.792	117.667	120.083	122.458	124.625	126.917
20	115.917	117.000	118.917	121.375	123.625	126.250
21	116.000	117.375	119.458	121.708	124.042	126.417
22	117.250	130.292	134.417	137.708	140.292	142.750
23	116.625	128.500	130.875	132.875	135.125	137.333
24	115.542	116.875	118.792	120.917	123.167	125.708
25	115.500	116.625	118.500	120.583	122.292	124.625
26	115.458	116.625	118.458	120.542	122.354	124.604
27	115.417	116.625	118.417	120.500	122.417	124.583
28	115.792	116.917	118.458	120.250	122.083	124.083
29	115.458	116.083	117.417	119.125	121.000	123.083
30	115.417	116.750	118.667	120.667	122.958	125.500
31	116.917	126.917	128.625	129.417	131.292	132.688
32	117.458	127.500	129.250	129.958	131.667	133.167
33	114.708	118.250	120.333	121.458	122.917	124.500
34	112.292	113.833	115.417	116.750	117.958	119.375

Table 5.3-2a. 6 IN. DIA TANK TEST 8G #9S (Page 2 of 2)

35	110.000	110.583	111.167	111.917	112.750	113.667
36	116.375	126.333	128.000	128.875	130.917	132.208
37	115.750	117.125	118.917	120.750	122.625	124.792
38	115.750	117.125	119.167	121.083	123.125	125.417
39	116.042	117.333	119.292	121.500	123.583	126.250
40	116.208	117.583	119.625	121.708	124.167	126.833
41	115.708	117.125	119.375	121.750	124.042	126.625
42	116.083	117.333	119.458	121.667	124.083	126.625
43	116.333	117.583	119.750	121.917	124.458	126.875
44	116.417	117.708	119.750	122.208	124.500	127.000
45	116.458	117.583	119.708	121.917	124.375	126.917
46	116.125	117.792	119.625	121.958	124.375	126.875
47	116.917	117.875	119.958	122.333	124.625	127.250
48	116.708	118.250	120.417	122.750	125.042	127.625
49	115.167	116.333	118.292	120.625	123.042	125.250
50	115.625	116.833	118.833	121.083	123.542	125.917
51	115.542	116.625	118.625	120.833	123.458	125.708
52	116.188	117.438	119.438	121.771	124.354	126.563
53	115.792	116.417	118.167	120.375	122.750	125.250
54	116.833	118.250	120.250	122.708	125.250	127.417
55	117.375	118.042	120.000	122.250	124.958	127.333
56	116.833	118.250	120.250	122.708	125.250	127.417
57	117.375	118.042	120.000	122.250	124.958	127.333
58	115.500	116.708	118.625	120.750	123.208	125.542
59	116.750	117.958	119.792	122.125	124.667	127.125
60	118.042	119.625	121.625	123.833	126.208	128.750
61	115.625	118.250	120.708	123.083	125.375	127.750
62	116.042	117.625	120.000	122.542	124.875	127.000
63	116.833	118.875	121.458	123.833	125.708	127.833
64	118.042	119.792	121.708	123.417	125.875	127.875
65	115.542	116.042	117.917	120.250	122.417	124.333
66	115.667	115.542	117.250	118.833	120.875	122.833
67	116.417	116.458	118.375	120.042	122.000	124.000
68	116.625	117.458	118.042	119.958	122.000	123.917
69	115.125	115.208	115.958	117.625	119.458	121.333
70	115.458	115.542	116.125	117.625	119.542	121.542
71	115.958	116.125	116.917	118.167	120.292	122.542
72	116.708	117.625	118.708	120.125	121.792	124.042
73	114.708	116.667	116.875	118.500	120.417	122.375
74	108.042	108.042	108.250	108.875	109.958	111.417
75	94.208	94.667	95.000	95.500	96.083	96.875
76	103.792	103.792	104.042	104.542	105.500	106.500
77	88.458	88.208	87.875	87.625	87.625	87.792

Table 5.3-2b. 6 IN. DIA TANK TEST 8G #15S (Page 1 of 2)

```
                                   TEMPERATURE MATRIX=STRATIFICATION


  TIME(MIN)     0,000     ,833    2,000    2,667    3,333
   TAU         0,000     ,250     ,600     ,800    1,000
     1        117,708  119.042  123.083  125,708  128,292
     2        117,625  119,208  123,458  126.000  128,375
     3        117,833  119,292  123,708  126,250  128,542
     4        118,042  119,750  123,958  126,583  128,875
     5        117,833  125.042  131,208  134,167  136,667
     6        118,167  129,167  135,750  138,375  140,625
     7        118,354  128,438  135,250  137,938  140,063
     8        118,542  127,708  134,750  137,500  139,500
     9        117,333  121,708  126,083  128,458  130,542
    10        117,417  118,375  123,250  125,833  128,125
    11        117,625  119,292  123,583  126.042  128,417
    12        118,750  132,958  139,625  142,375  144,500
    13        118,375  131,042  134,958  137,250  139,167
    14        117,125  118,708  122,875  125,500  127,958
    15        117,417  119,083  123,250  125,917  128,292
    16        117,667  119,375  123,708  126,167  128,542
    17        117,771  125,708  131,354  133,719  136,031
    18        117,333  125,250  131,042  133,167  135,542
    19        116,792  120,167  124,375  126,667  128,792
    20        117,417  118,875  123,250  125,833  128,125
    21        117,625  119,292  123,583  126,042  128,417
    22        118,750  132,958  139,625  142,375  144,500
    23        118,375  131,042  134,958  137,250  139,167
    24        117,292  118,792  122,625  124,875  127,292
    25        117,000  118,583  122,167  124,250  126,167
    26        116,958  118,604  122,083  124,063  125,875
    27        116,917  118,625  122,000  123,875  125,583
    28        117,292  118,792  121,542  123,375  125,125
    29        116,875  117,833  120,750  122,625  124,458
    30        117,125  118,708  122,417  124,917  127,208
    31        118,569  129,319  131,472  133,347  135,069
    32        119,208  130,125  131,917  133,708  135,208
    33        116,333  120,708  123,125  124,792  126,208
    34        113,542  114,875  117,708  119,083  120,250
```

Table 5. 3-2b. 6 IN. DIA TANK TEST 8G #15S (Page 2 of 2)

35	109,625	110,250	111,750	112,750	113,583
~~36~~	~~118,250~~	~~128,917~~	~~131,250~~	~~133,167~~	~~135,000~~
37	117,333	119,083	122,417	124,333	126,292
38	117,333	119,083	122,667	124,958	127,083
~~39~~	~~117,583~~	~~119,250~~	~~123,125~~	~~125,625~~	~~128,000~~
40	117,792	119,583	123,625	126,167	128,625
41	117,542	119,333	123,417	126,125	128,625
~~42~~	~~117,542~~	~~119,500~~	~~123,500~~	~~126,292~~	~~128,708~~
43	117,667	119,667	123,708	126,458	128,875
44	117,958	119,792	123,875	126,583	129,125
~~45~~	~~117,625~~	~~119,625~~	~~123,667~~	~~126,583~~	~~129,042~~
46	117,583	119,500	123,792	126,583	129,000
47	117,958	119,917	124,042	126,833	129,125
~~48~~	~~118,250~~	~~120,250~~	~~124,667~~	~~127,417~~	~~129,750~~
49	116,375	118,250	122,667	125,000	127,208
50	116,833	118,625	123,208	125,417	127,792
~~51~~	~~116,625~~	~~118,500~~	~~123,000~~	~~125,250~~	~~127,542~~
52	117,354	119,333	123,875	126,104	128,375
53	116,250	118,083	122,708	125,000	127,208
~~54~~	~~118,083~~	~~120,167~~	~~124,750~~	~~126,958~~	~~129,208~~
55	117,917	120,000	124,458	126,750	129,042
56	118,083	120,167	124,750	126,958	129,208
~~57~~	~~117,917~~	~~120,000~~	~~124,458~~	~~126,750~~	~~129,042~~
58	116,417	118,542	123,083	125,292	127,500
59	117,667	119,875	124,333	126,625	128,875
~~60~~	~~119,000~~	~~121,292~~	~~125,917~~	~~128,292~~	~~130,583~~
61	116,833	120,250	125,542	127,917	129,917
62	116,750	119,583	124,750	126,750	128,917
63	118,083	120,792	126,125	128,333	130,292
64	119,125	121,583	126,167	127,833	130,167
65	116,792	117,958	122,500	124,375	126,333
~~66~~	~~116,917~~	~~117,375~~	~~121,167~~	~~122,833~~	~~124,792~~
67	117,875	118,375	122,125	123,792	125,625
68	118,792	118,917	121,833	123,708	125,708
~~69~~	~~116,625~~	~~116,792~~	~~119,625~~	~~121,458~~	~~123,167~~
70	116,792	117,125	119,583	121,500	123,292
71	117,333	117,633	120,458	122,208	124,292
~~72~~	~~118,000~~	~~119,375~~	~~122,292~~	~~123,792~~	~~125,625~~
73	115,958	117,792	120,917	122,500	124,292
74	109,792	110,125	111,333	112,250	113,292
~~75~~	~~97,583~~	~~97,958~~	~~99,042~~	~~99,375~~	~~99,792~~
76	106,792	106,958	108,333	108,917	109,583
77	93,042	92,792	92,792	92,625	92,458

Table 5.3-2c. 12 IN. DIA TANK TEST 1G #33 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	3,000	6,000	8,000	10,000	12,000	13,000
TAU	0,000	,231	,462	,615	,769	,923	1,000
1	116,438	117,000	118,667	119,833	121,125	122,667	123,542
2	116,688	117,500	119,500	121,083	122,917	124,833	125,875
3	117,171	118,042	120,458	122,167	124,083	125,917	126,833
4	117,575	118,917	121,500	123,083	124,625	126,208	127,083
5	117,563	124,125	127,542	129,250	131,833	132,417	133,333
6	117,579	124,875	128,167	129,917	131,458	133,125	134,042
7	117,713	124,467	127,750	129,375	131,042	132,750	133,708
8	117,738	124,917	127,625	129,458	131,042	132,792	133,375
9	117,300	121,542	124,583	126,417	128,042	129,792	130,563
^{7}10	116,677	117,292	119,333	121,000	122,708	124,625	125,708
11	117,467	118,708	121,250	122,875	124,417	126,000	126,750
12	119,079	130,750	133,958	135,667	137,250	139,042	139,958
13	119,725	131,292	133,833	135,417	137,208	138,833	139,417
14	116,229	116,750	118,333	119,542	121,375	122,417	123,292
15	116,658	117,458	119,417	121,042	122,792	124,792	125,833
16	131,150	119,917	121,458	123,000	124,542	126,083	126,875
17	118,292	129,125	132,417	134,250	135,958	137,458	138,375
18	118,042	128,042	130,500	131,958	133,708	135,417	136,292
19	117,333	121,167	124,000	125,750	127,417	129,000	129,792
20	117,250	117,583	119,500	121,167	123,000	124,917	125,917
21	117,500	118,667	121,250	122,750	124,292	125,833	126,750
22	120,375	130,625	134,042	135,875	137,583	139,000	140,083
23	120,417	130,833	133,417	134,958	136,625	138,208	139,250
24	116,083	116,625	118,042	118,958	119,875	120,375	121,458
25	115,292	115,958	117,125	117,792	118,417	119,083	119,458
26	113,125	114,458	116,167	116,875	117,292	117,750	117,958
27	110,708	110,708	113,500	114,750	115,083	115,208	115,250
28	116,083	116,125	116,917	117,500	118,042	118,583	119,000
29	115,833	115,917	116,833	117,458	118,125	118,708	119,125
30	115,917	116,458	117,833	118,833	119,750	120,708	121,208
31	120,917	130,563	132,917	134,667	136,292	137,833	138,708
32	120,000	129,125	131,500	133,167	134,750	136,417	137,167
33	115,563	120,250	122,333	123,708	125,042	126,375	127,083
34	114,958	114,667	115,042	115,458	115,792	116,250	116,542

Table 5.3-2c. 12 IN. DIA TANK TEST 1G #33 (Page 2 of 2)

35	114,667	113,625	113,083	112,792	112,500	112,208	112,167
36	121,250	130,792	133,042	134,917	136,500	138,042	138,833
37	116,917	117,000	117,417	118,250	118,917	119,625	120,042
38	116,917	117,000	117,833	118,750	119,458	120,375	120,750
39	116,792	116,917	118,167	119,292	120,250	121,292	121,792
40	117,208	117,250	118,542	119,625	120,833	122,083	122,708
41	117,125	117,125	118,625	119,917	121,208	122,667	123,500
42	117,208	117,250	118,750	120,000	121,292	122,792	123,667
43	116,708	117,250	118,833	120,125	121,375	122,958	123,667
44	116,750	117,458	119,083	120,333	121,667	123,167	123,958
45	117,208	117,292	118,750	120,083	121,333	122,792	123,583
46	116,542	117,167	118,792	120,083	121,417	123,000	123,750
47	117,375	117,458	118,833	120,167	121,375	122,833	123,667
48	117,583	117,875	119,667	121,208	122,958	124,708	125,750
49	117,667	118,000	119,917	121,708	123,500	125,333	126,292
50	117,708	118,125	120,208	122,167	124,042	125,958	126,792
51	117,708	118,208	120,708	122,667	124,333	126,042	127,042
52	117,500	118,125	120,792	122,583	124,417	126,000	127,083
53	117,167	117,917	120,625	122,500	124,167	125,792	126,875
54	117,417	118,292	120,917	122,833	124,500	126,167	127,167
55	117,750	118,125	120,792	122,625	124,292	125,917	127,042
56	117,375	118,167	120,792	122,542	124,333	126,000	127,042
57	118,042	118,167	120,708	122,667	124,208	125,917	127,042
58	117,625	118,542	121,417	123,167	124,667	126,250	127,250
59	117,625	119,042	121,750	123,208	124,583	126,083	127,083
60	117,708	119,875	122,833	124,500	126,000	127,542	128,625
61	117,917	119,708	122,667	124,250	125,792	127,375	128,333
62	117,958	119,625	122,667	124,542	126,042	127,708	128,667
63	117,708	119,417	122,625	124,208	125,792	127,333	128,458
64	117,708	118,833	121,750	123,458	125,000	126,500	127,750
65	117,708	118,917	121,917	123,625	125,083	126,750	127,833
66	117,667	118,542	121,250	122,833	124,250	125,958	126,958
67	117,667	118,542	121,250	122,833	124,250	125,958	126,958
68	117,708	118,208	120,833	122,333	123,792	125,417	126,542
69	117,750	118,333	120,792	122,333	123,792	125,500	126,500
70	117,625	118,167	120,500	122,000	123,542	125,208	126,250
71	117,625	118,167	120,500	122,000	123,542	125,208	126,250
72	117,667	118,167	120,667	122,292	123,708	125,208	126,250
73	117,667	118,208	120,625	122,000	123,542	125,083	126,167
74	95,625	95,375	95,667	95,708	95,583	95,667	95,917
75	105,792	105,333	105,833	106,000	106,083	106,417	106,875
▼76	88,042	87,750	88,125	88,000	87,833	87,708	88,042
77	98,750	98,500	98,917	99,000	99,083	99,250	99,583

Table 5.3-2d. 12 IN. DIA TANK TEST 1G #32 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

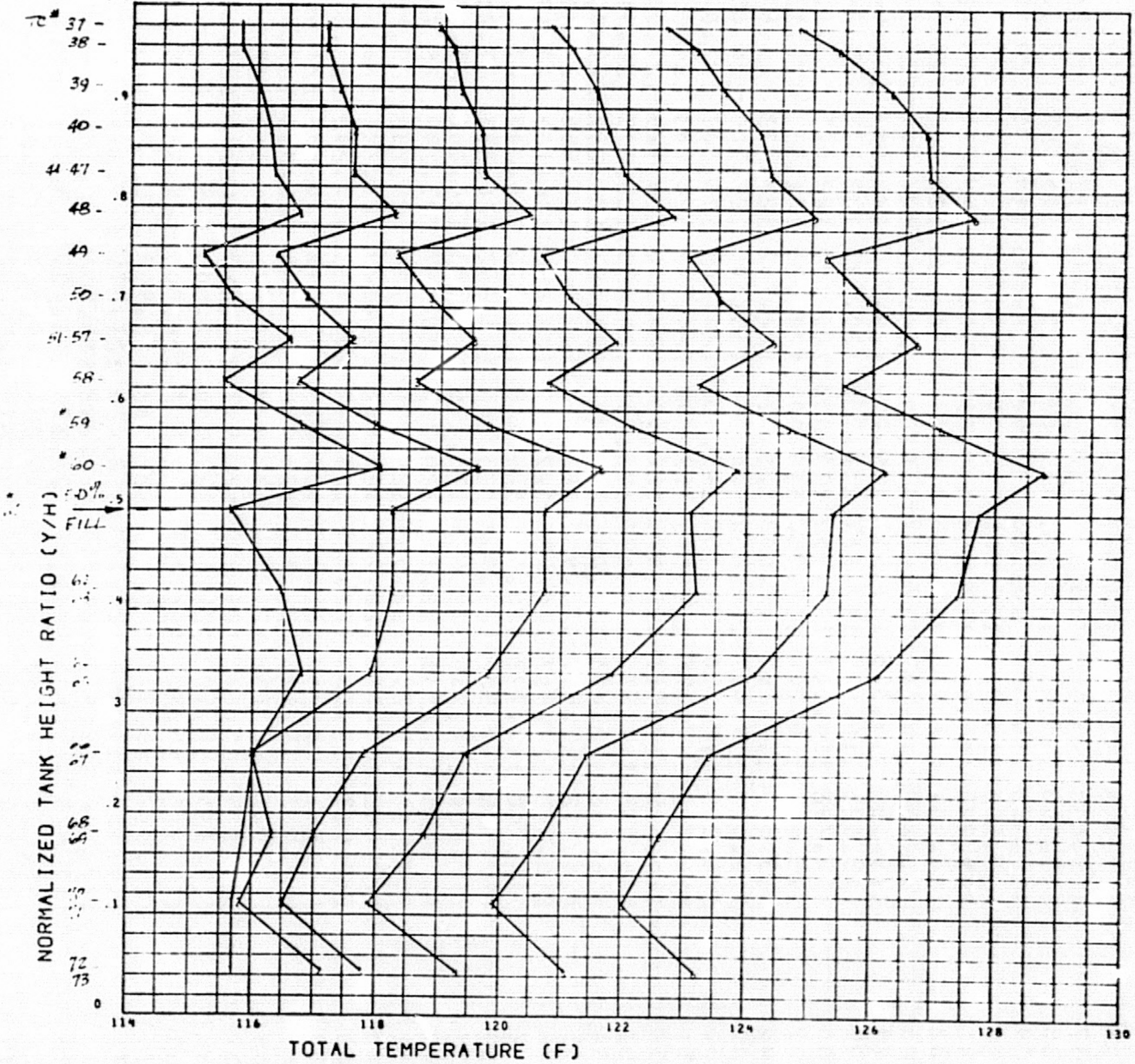
TIME(MIN)	0.000	3.000	6.000	8.000	10.000	12.000	13.000
TAU	0.000	.231	.462	.615	.769	.923	1.000
1	114.875	115.958	117.458	118.833	120.542	122.250	123.125
2	115.417	116.875	119.000	120.875	123.125	125.083	126.083
3	116.292	117.792	120.375	122.250	124.292	126.083	126.875
4	117.083	118.917	121.292	122.875	124.625	126.292	127.042
5	117.583	124.417	127.375	129.167	131.083	132.708	133.375
6	117.583	125.208	127.917	129.833	131.667	133.292	134.000
7	117.708	125.000	127.583	129.375	131.208	132.792	133.667
8	117.792	125.333	127.750	129.375	131.208	132.917	133.583
9	117.375	121.833	124.667	126.375	128.417	130.042	130.875
10	115.333	116.792	118.875	120.708	122.958	124.958	125.958
11	116.792	118.708	121.042	122.667	124.417	126.000	126.750
12	117.750	130.958	133.708	135.542	137.417	139.000	139.792
13	117.583	131.417	133.708	135.542	137.583	138.917	139.875
14	114.542	115.708	117.208	118.500	120.250	121.958	122.875
15	115.375	116.875	119.000	120.875	123.167	125.208	126.042
16	116.958	118.917	121.167	122.792	124.542	126.167	126.917
17	117.458	129.250	132.083	133.917	135.750	137.458	138.458
18	117.375	128.125	130.500	131.958	133.667	135.417	136.042
19	117.167	121.417	124.083	125.708	127.542	129.292	130.042
20	115.458	116.958	119.125	120.917	123.167	125.208	126.125
21	116.708	118.708	120.958	122.542	124.333	125.917	126.667
22	117.500	130.917	133.875	135.625	137.500	139.333	140.125
23	117.500	131.083	133.333	134.875	136.958	138.500	139.208
24	114.125	115.167	116.417	117.292	118.417	119.542	119.958
25	113.542	114.333	115.083	115.792	116.625	117.208	117.542
26	112.917	113.500	114.167	114.625	115.167	115.542	115.708
27	112.458	112.417	113.000	113.208	113.500	113.542	113.417
28	113.958	114.458	114.875	115.458	116.083	116.750	117.042
29	113.708	114.250	114.792	115.375	116.250	117.000	117.292
30	113.833	114.958	116.167	117.083	118.292	119.333	119.792
31	117.542	131.000	133.208	134.833	136.542	138.292	139.042
32	117.333	129.583	131.833	133.375	135.208	136.750	137.583
33	115.625	120.750	122.542	123.750	125.208	126.625	127.333
34	115.333	115.333	115.292	115.542	116.125	116.500	116.708

Table 5.3-2d. 12 IN. DIA TANK TEST 1G #32 (Page 2 of 2)

35	115.125	114.250	113.500	113.000	112.792	112.667	112.500
▼ 36	117.958	131.333	133.417	135.000	136.750	138.375	139.333
37	115.000	115.167	115.583	116.250	117.083	117.917	118.208
38	115.208	115.417	116.000	116.833	117.833	118.792	119.167
39	115.333	115.583	116.708	117.625	118.833	119.875	120.458
40	115.583	115.917	117.208	118.292	119.708	121.125	121.750
41	115.292	116.042	117.458	118.833	120.500	122.208	123.083
42	114.833	116.125	117.625	118.875	120.625	122.417	123.292
43	115.208	116.167	117.667	119.000	120.667	122.500	123.292
44	115.125	116.375	117.917	119.292	120.917	122.667	123.542
45	115.625	116.125	117.667	118.958	120.625	122.375	123.208
46	114.792	116.167	117.750	119.083	120.708	122.625	123.417
47	115.667	116.208	117.750	119.000	120.625	122.375	123.125
48	115.833	117.083	119.042	120.708	122.792	124.833	125.875
49	116.021	117.417	119.604	121.396	123.500	125.500	126.458
50	116.208	117.750	120.167	122.083	124.208	126.167	127.042
51	116.792	117.875	120.875	122.792	124.542	126.083	127.000
52	116.625	117.917	120.875	122.875	124.500	126.125	127.042
53	116.458	117.750	120.667	122.708	124.333	125.875	126.917
54	116.708	118.083	121.000	122.958	124.667	126.292	127.083
55	116.792	117.917	120.917	122.750	124.500	125.958	127.000
56	116.750	117.917	120.875	122.792	124.458	126.167	127.125
57	116.708	117.792	120.875	122.708	124.375	126.042	127.000
58	117.125	118.542	121.458	123.208	124.792	126.333	127.208
59	117.208	118.958	121.625	123.125	124.583	126.042	127.083
60	117.833	119.833	122.792	124.708	126.167	127.792	128.708
61	118.000	119.750	122.583	124.250	125.708	127.250	128.208
62	118.042	119.875	122.792	124.500	126.125	127.792	128.667
63	117.917	119.583	122.625	124.417	125.833	127.292	128.542
64	117.833	118.958	121.833	123.417	125.042	126.583	127.667
65	117.917	119.000	121.917	123.750	125.208	126.833	127.833
66	117.847	118.722	121.389	122.944	124.486	126.042	127.097
67	117.875	118.792	121.292	122.917	124.417	126.042	127.042
68	117.833	118.417	121.042	122.500	124.000	125.500	126.583
69	117.917	118.542	121.042	122.542	124.000	125.625	126.625
70	117.819	118.347	120.903	122.333	123.903	125.403	126.444
71	117.833	118.292	120.750	122.208	123.875	125.333	126.375
72	117.792	118.333	120.917	122.292	123.833	125.375	126.375
73	117.875	118.375	120.708	122.375	123.750	125.333	126.333
74	95.000	94.750	95.083	95.083	95.083	95.083	95.292
75	104.458	104.208	104.750	104.875	105.042	105.458	105.792
76	87.542	87.292	87.625	87.542	87.458	87.292	87.500
77	98.208	98.000	98.458	98.500	98.583	98.792	99.042

FIGURE 5.3-1a

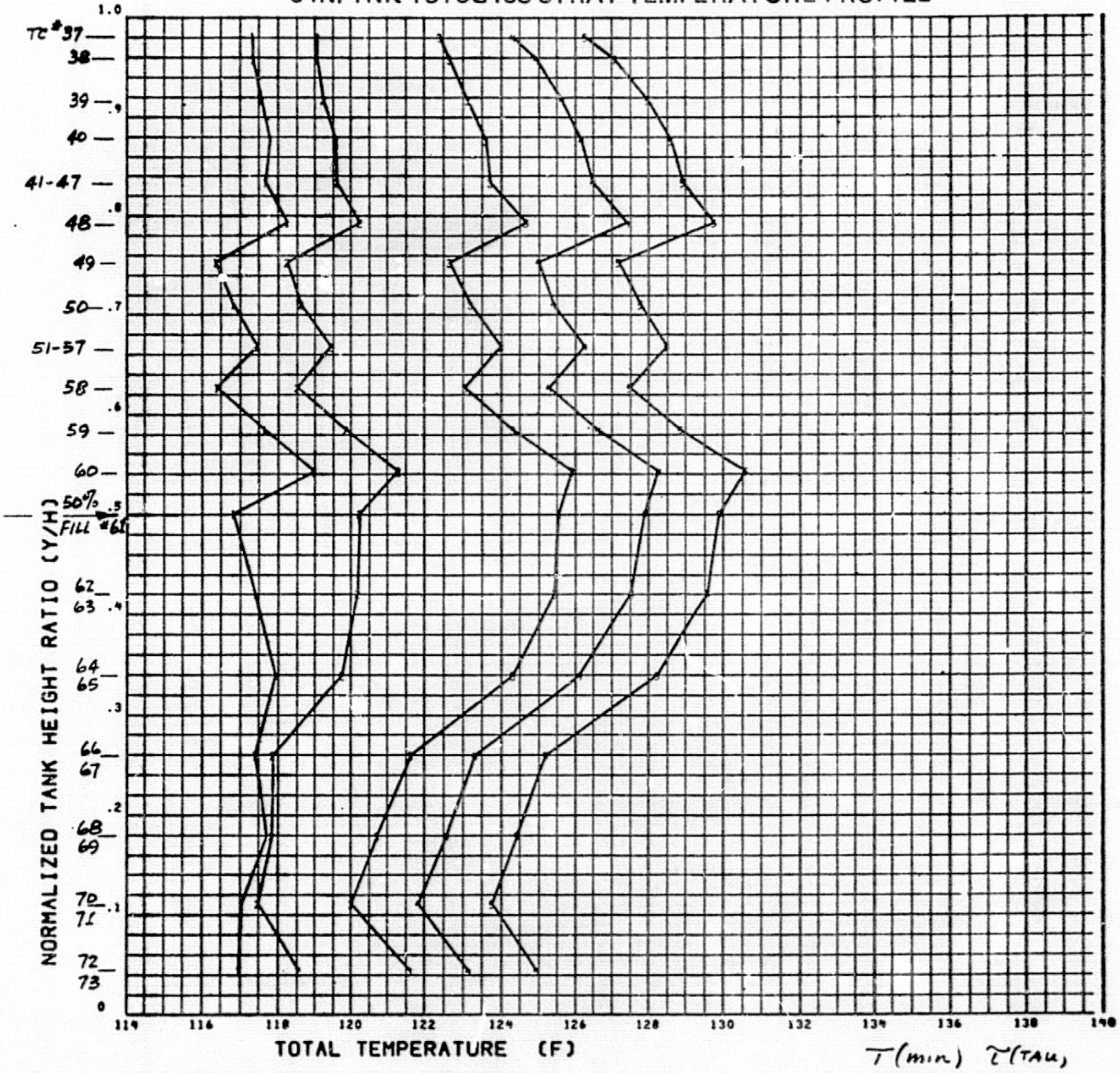
6 IN. TNK TEST 8GΣ9S – STRAT TEMPERATURE PROFILE



$\dot{q}''_H$ = 700 BTU/hr ft²   LIQ HT'G ONLY

	T(min)	[illegible]
1	0.	0.
2	.667	.2
3	1.333	.4
4	2.	.6
5	2.667	.8
6	3.333	1.0

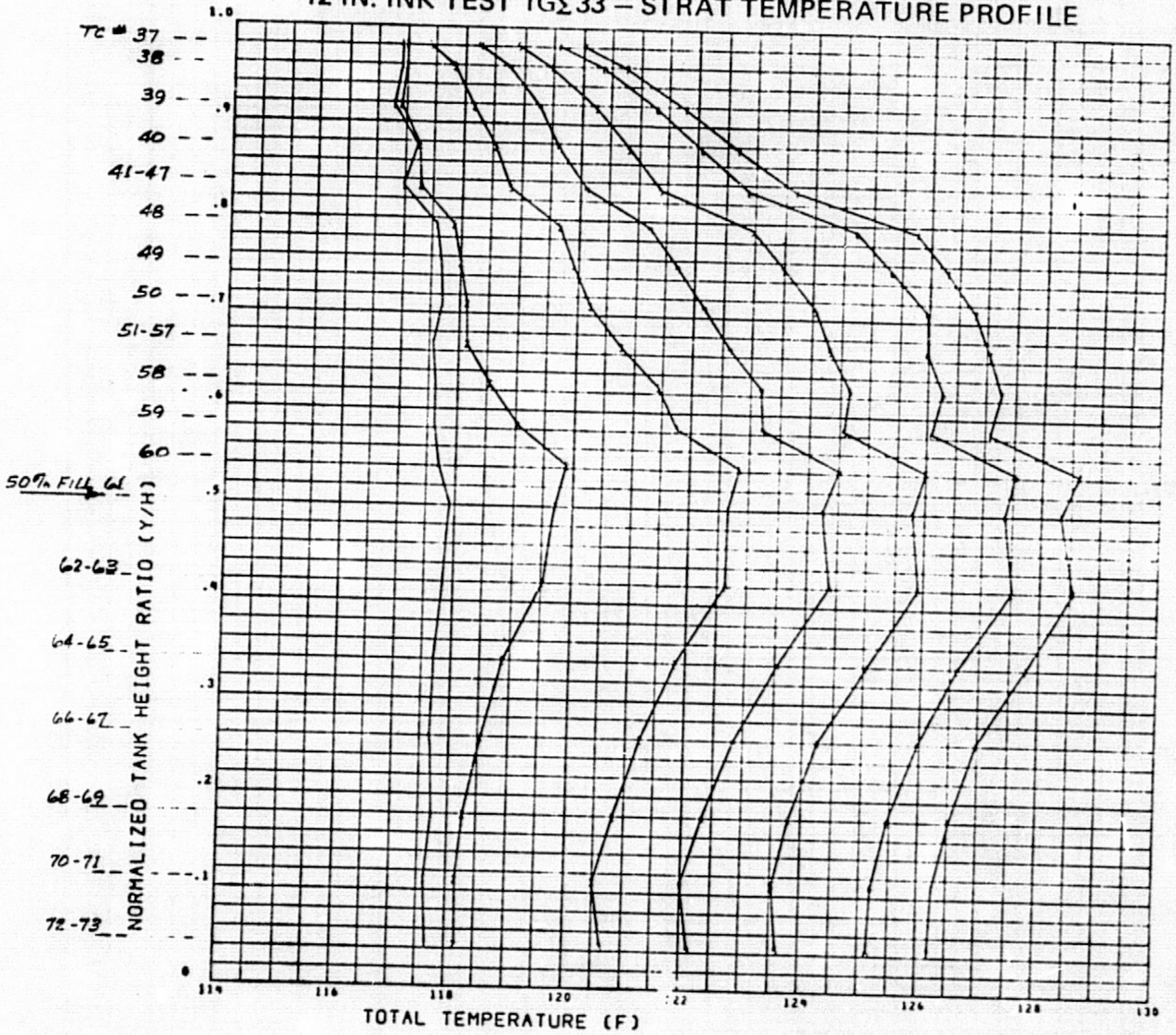
FIGURE 5.3-1b
6 IN. TNK TST8G15S STRAT TEMPERATURE PROFILE



q''_{θ_H} = 700 BTU/hr ft^2 LIQ HTG

	T (min)	τ (TAU)
1	0.	0.
2	.833	.250
3	2.	.600
4	2.667	.800
5	3.333	1.000

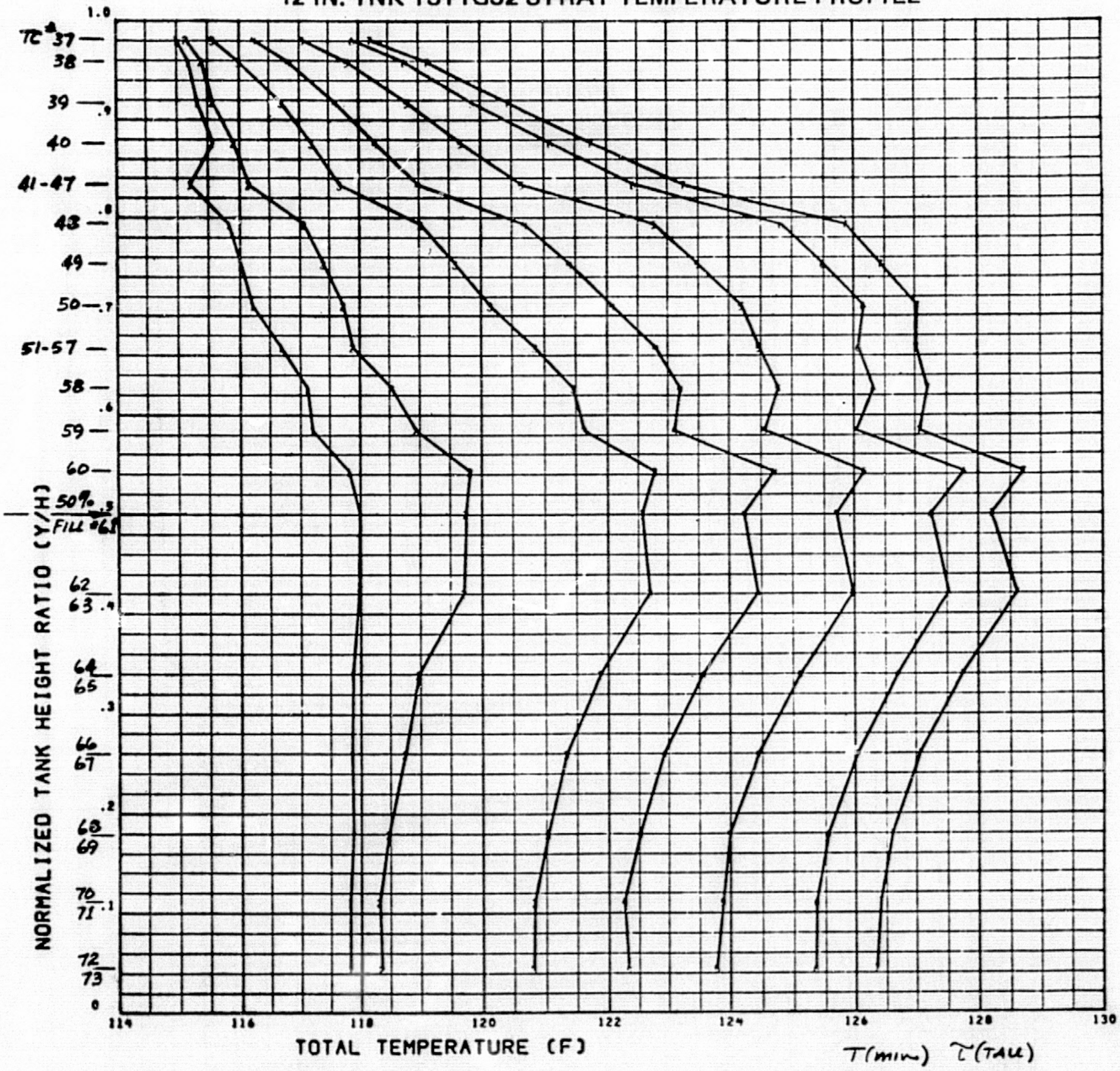
FIGURE 5.3-1c
12 IN. INK TEST 1GΣ33 – STRAT TEMPERATURE PROFILE



q''_H = 350 BTU/hr ft² LIQ HTG ONLY

	T(min)	TAU
1	0.	0.
2	3.0	.231
3	6.0	.462
4	8.0	.615
5	10.0	.769
6	12.0	.923
7	13.0	1.0

FIGURE 5.3-1d
12 IN. TNK TST1G32 STRAT TEMPERATURE PROFILE



q''_H = 350 BTU/hr ft² LIQ HTG

	T(min)	τ(TAU)
1	0.	0.
2	3.	.231
3	6.	.462
4	8.	.615
5	10.	.769
6	12.	.923
7	13.	1.000

FIGURE 5.3-2a

6 IN. TNK TEST 8GΣ9S – STRAT DEL. – TEMP PROFILE

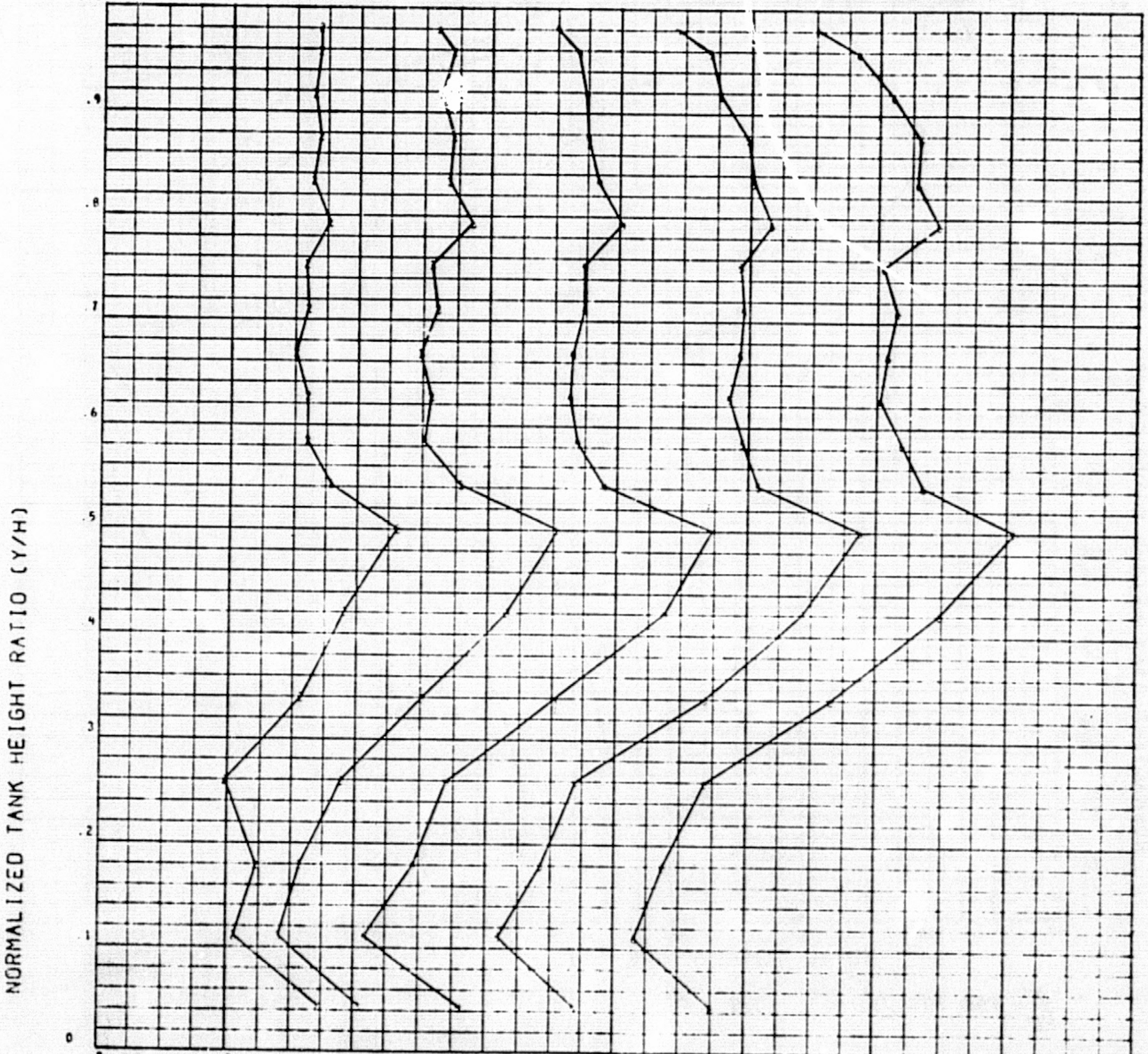


FIGURE 5.3-2b
6 IN. TNK TST8G15S STRAT DEL – TEMP PROFILE

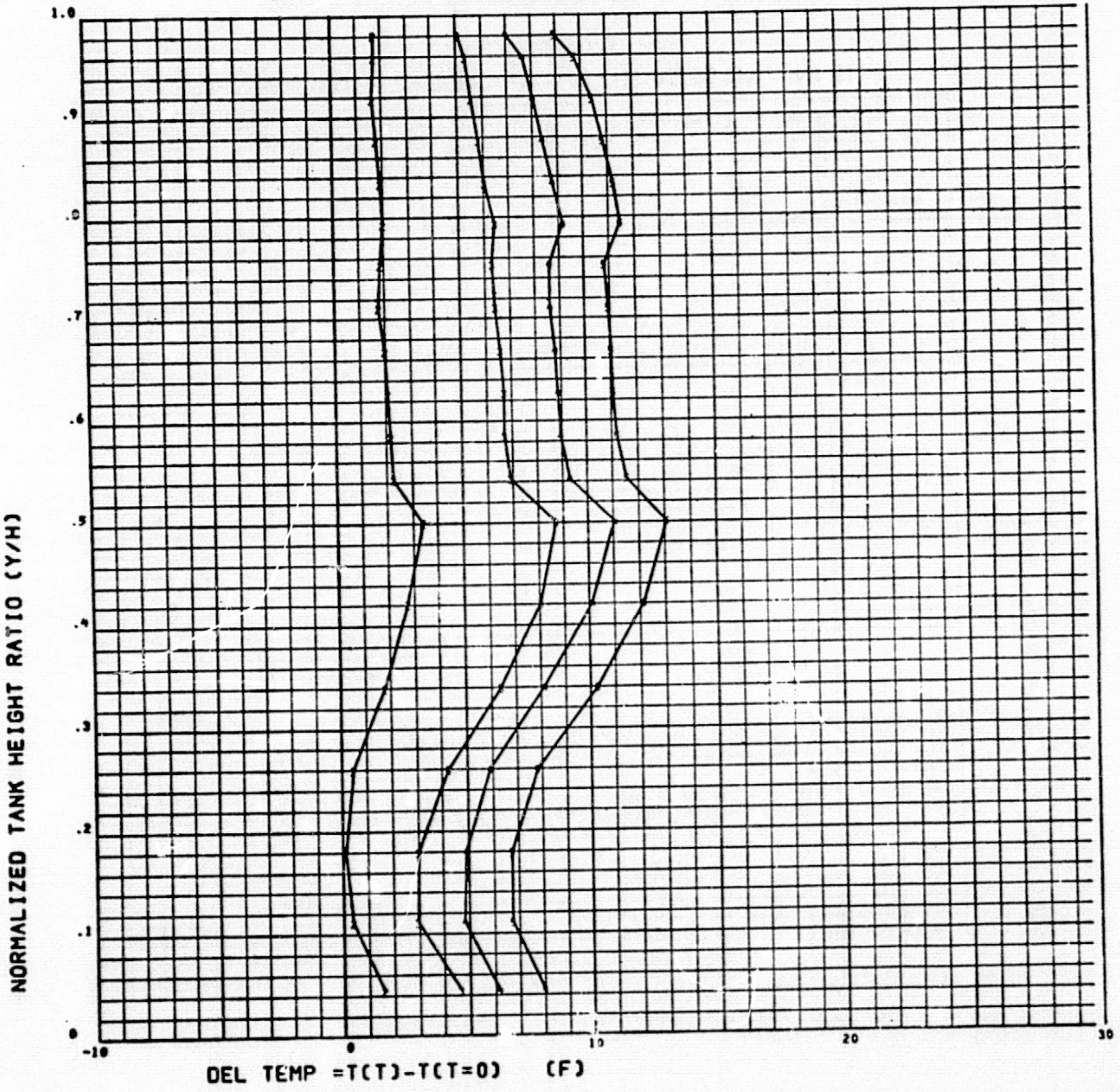


FIGURE 5.3-2c

12 IN. TNK TEST 1GΣ33 — STRAT DEL — TEMP PROFILE

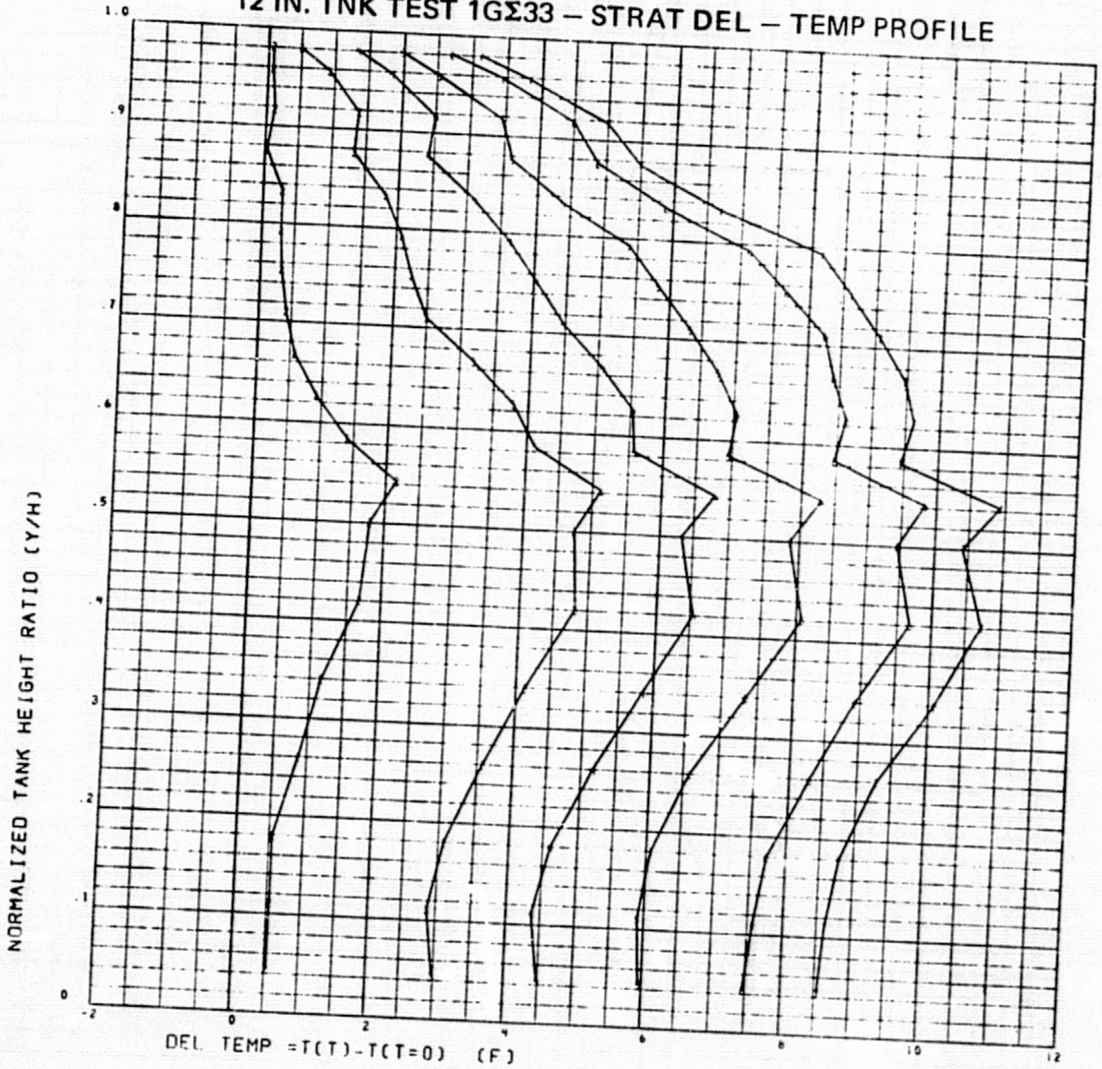


FIGURE 5.3-2d

12 IN. TNK TST1G32 STRAT DEL – TEMP PROFILE

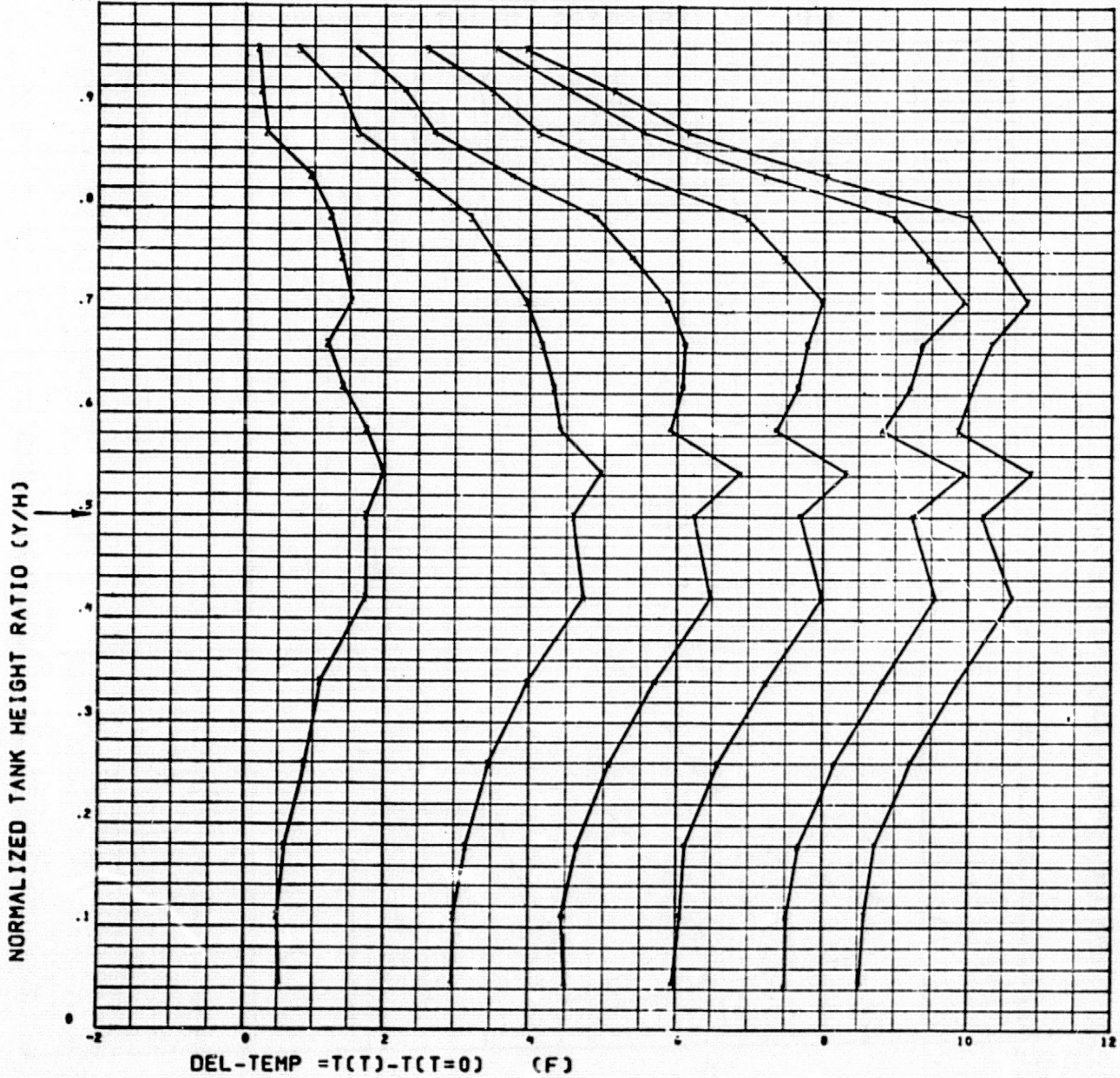


Figure 5.3-3a

6 IN. TNK TEST 8GΣ9S – STRAT DTNORM PROFILE

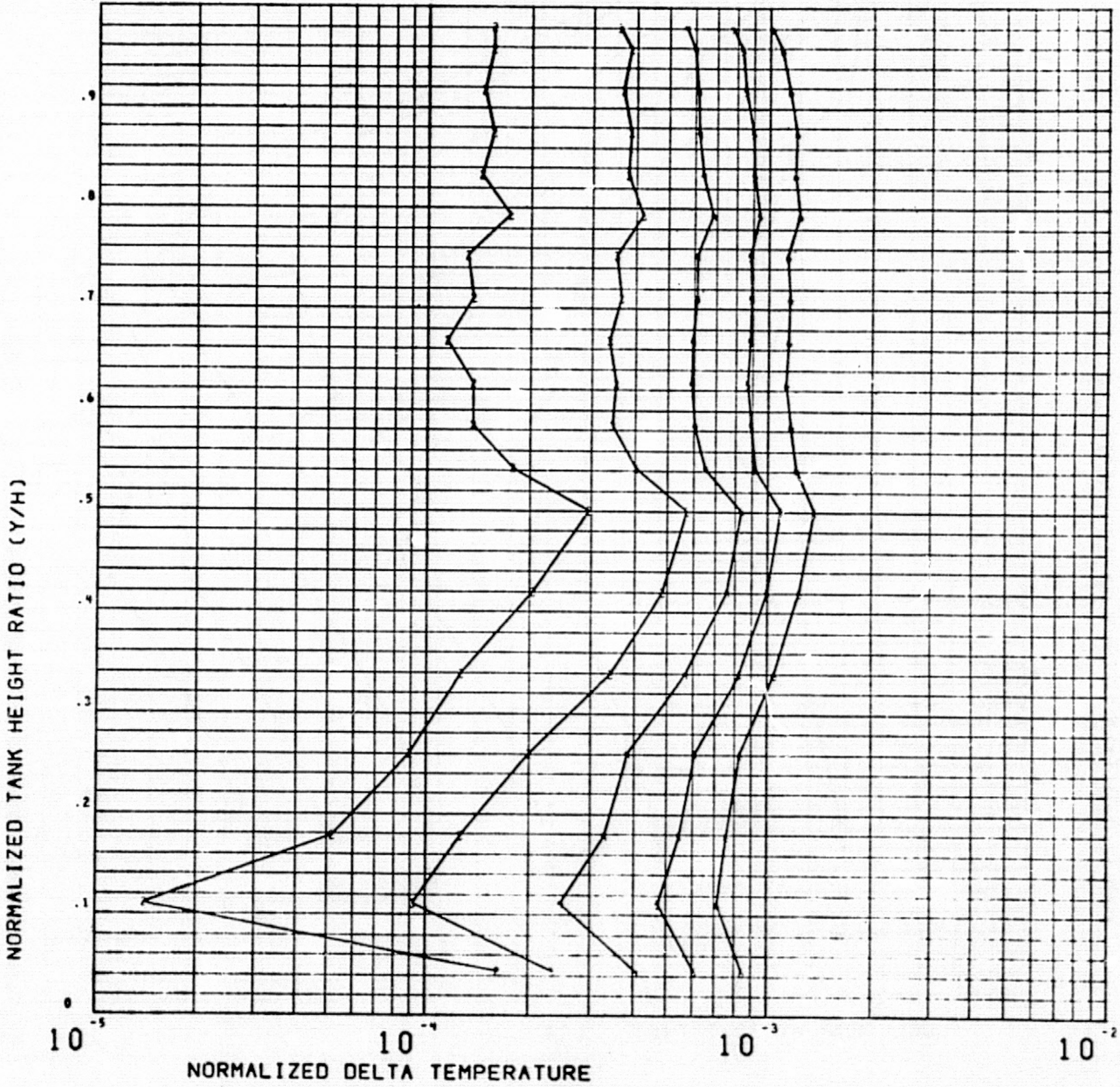


FIGURE 5.3-3b
6 IN. TNK TST8G15S STRAT DTNORM PROFILE

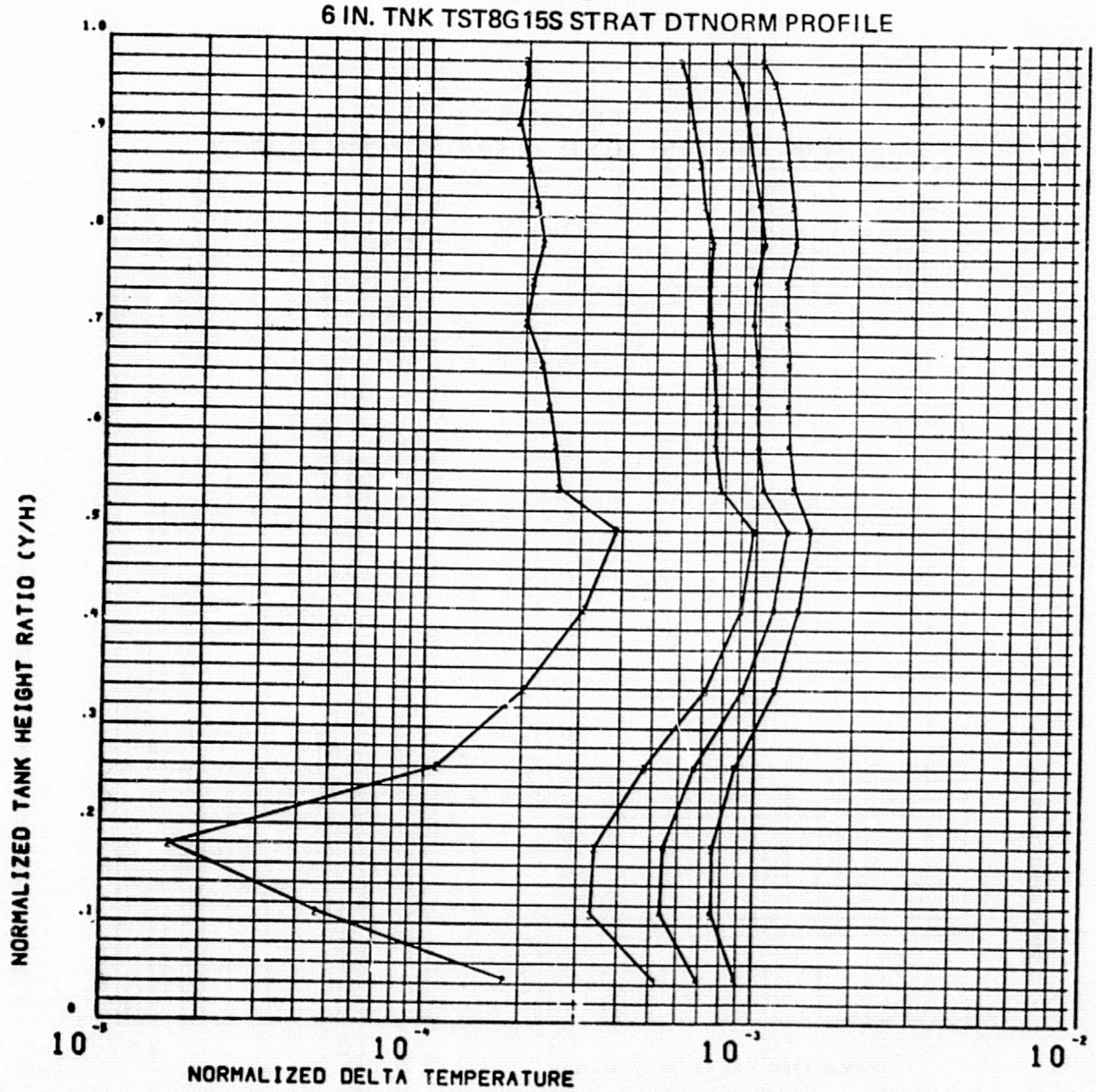


FIGURE 5.3-3c

12 IN. TNK TEST 1GΣ33 – STRAT DTNORM PROFILE

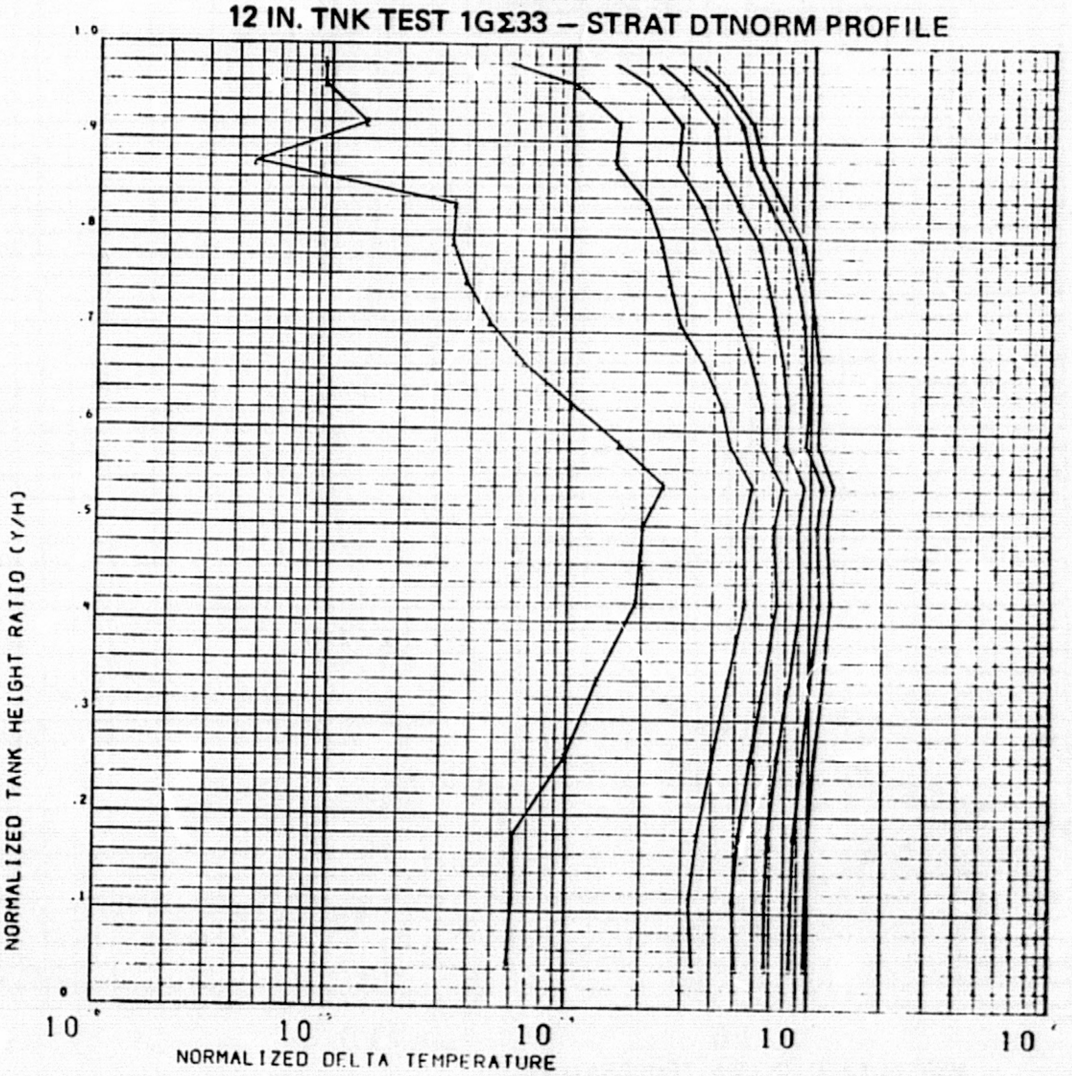


FIGURE 5.3-3d
12 IN. TNK TST1G32 STRAT DTNORM PROFILE

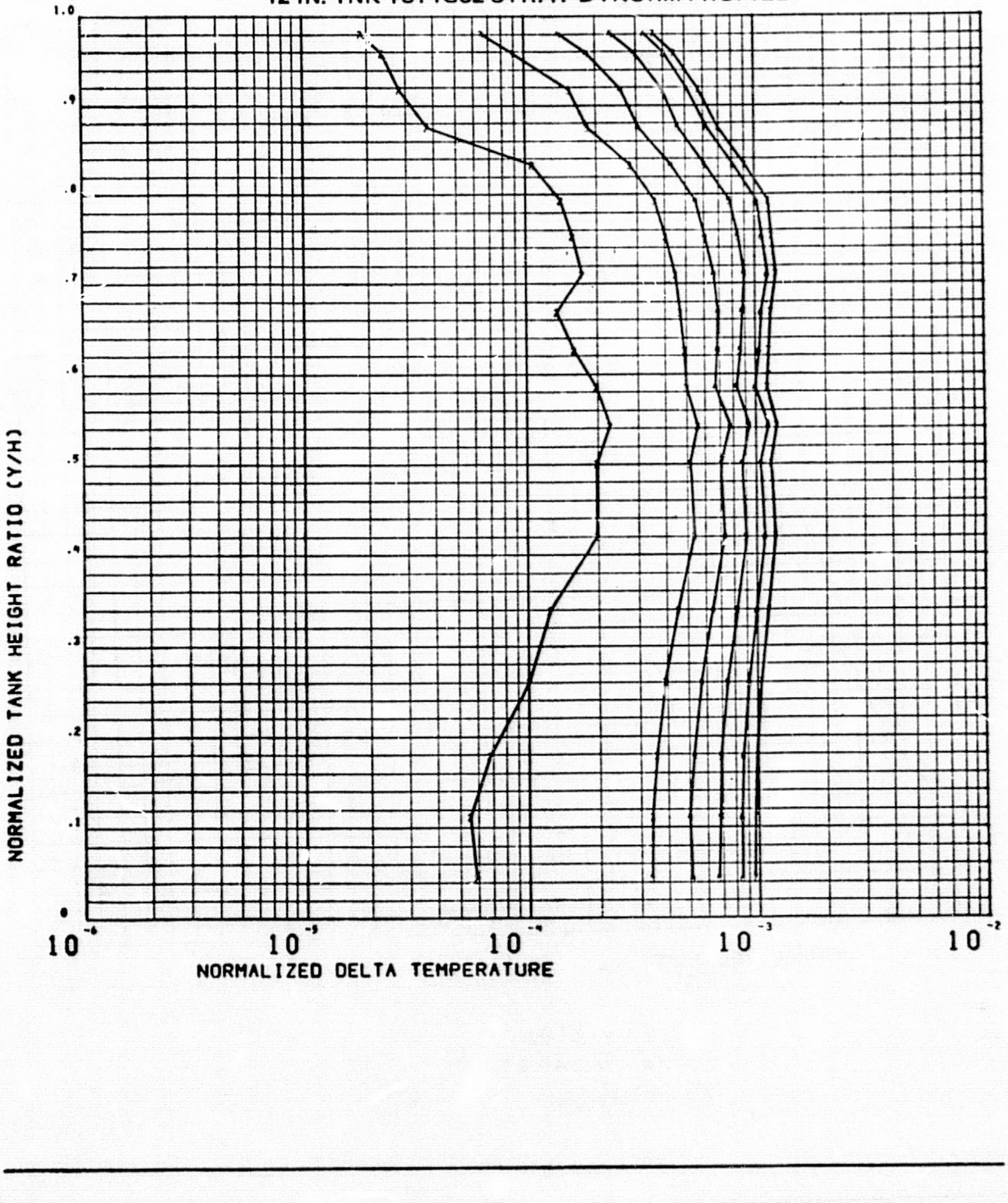
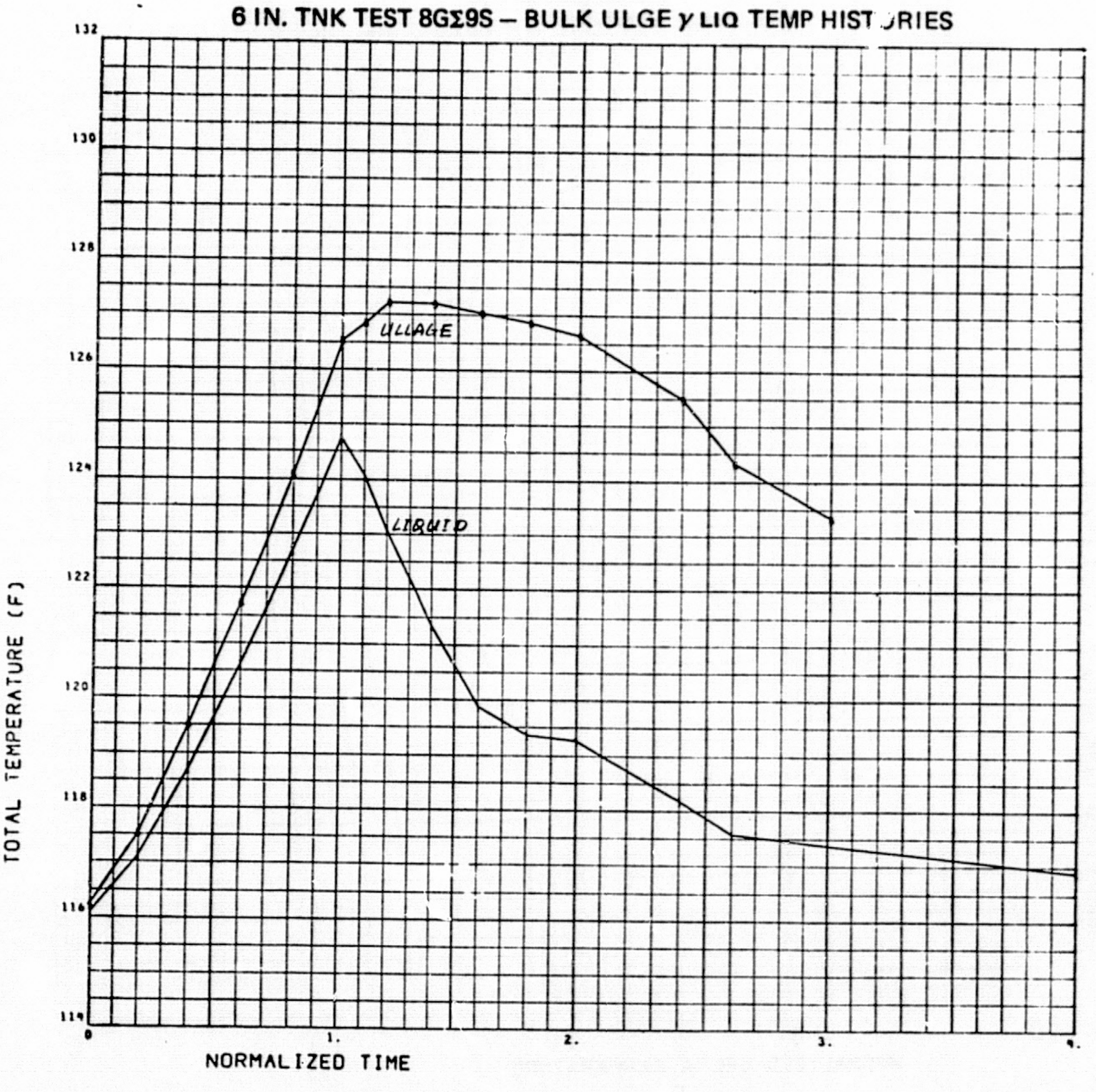


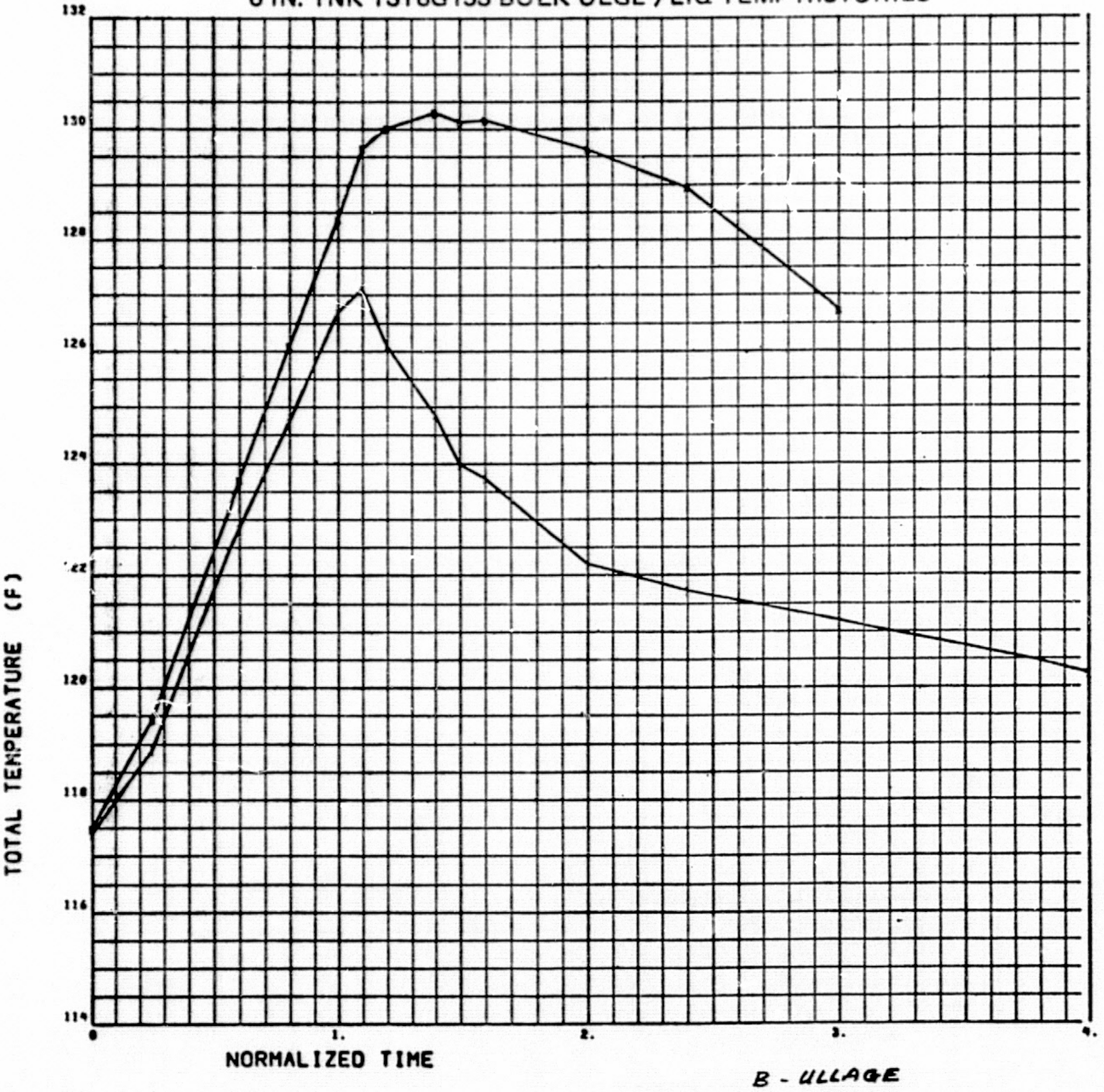
FIGURE 5.3-4a
6 IN. TNK TEST 8GΣ9S – BULK ULGE γ LIQ TEMP HISTORIES



1 - LIQUID
B - ULLAGE

FIGURE 5.3-4b

6 IN. TNK TST8G15S BULK ULGE γ LIQ TEMP HISTORIES



B - ULLAGE
1 - LIQUID

FIGURE 5.3-4c
12 IN. TNK TEST 1GΣ33 — BULK ULGE γ LIQ TEMP HISTORIES

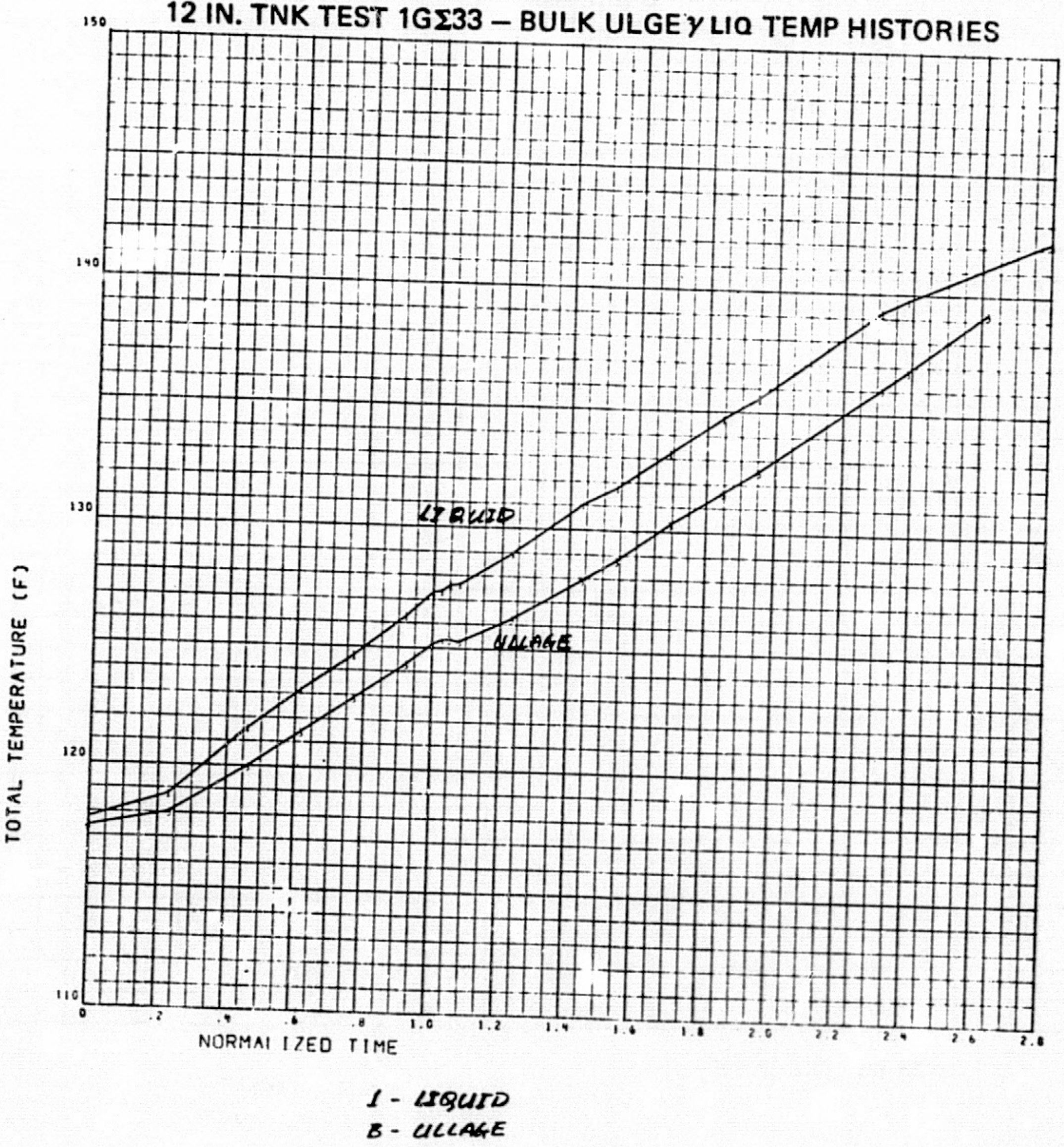
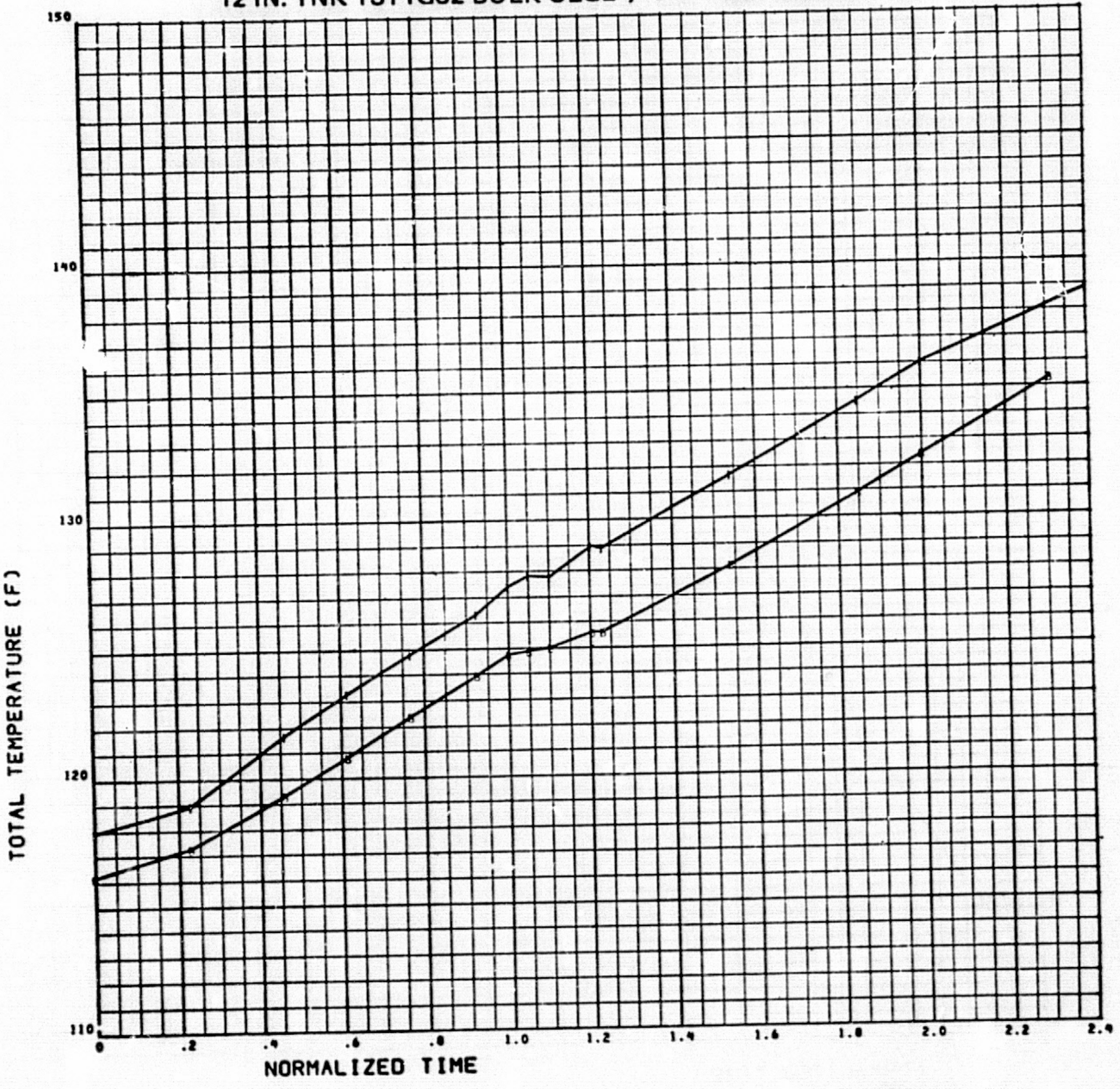


FIGURE 5.3-4d

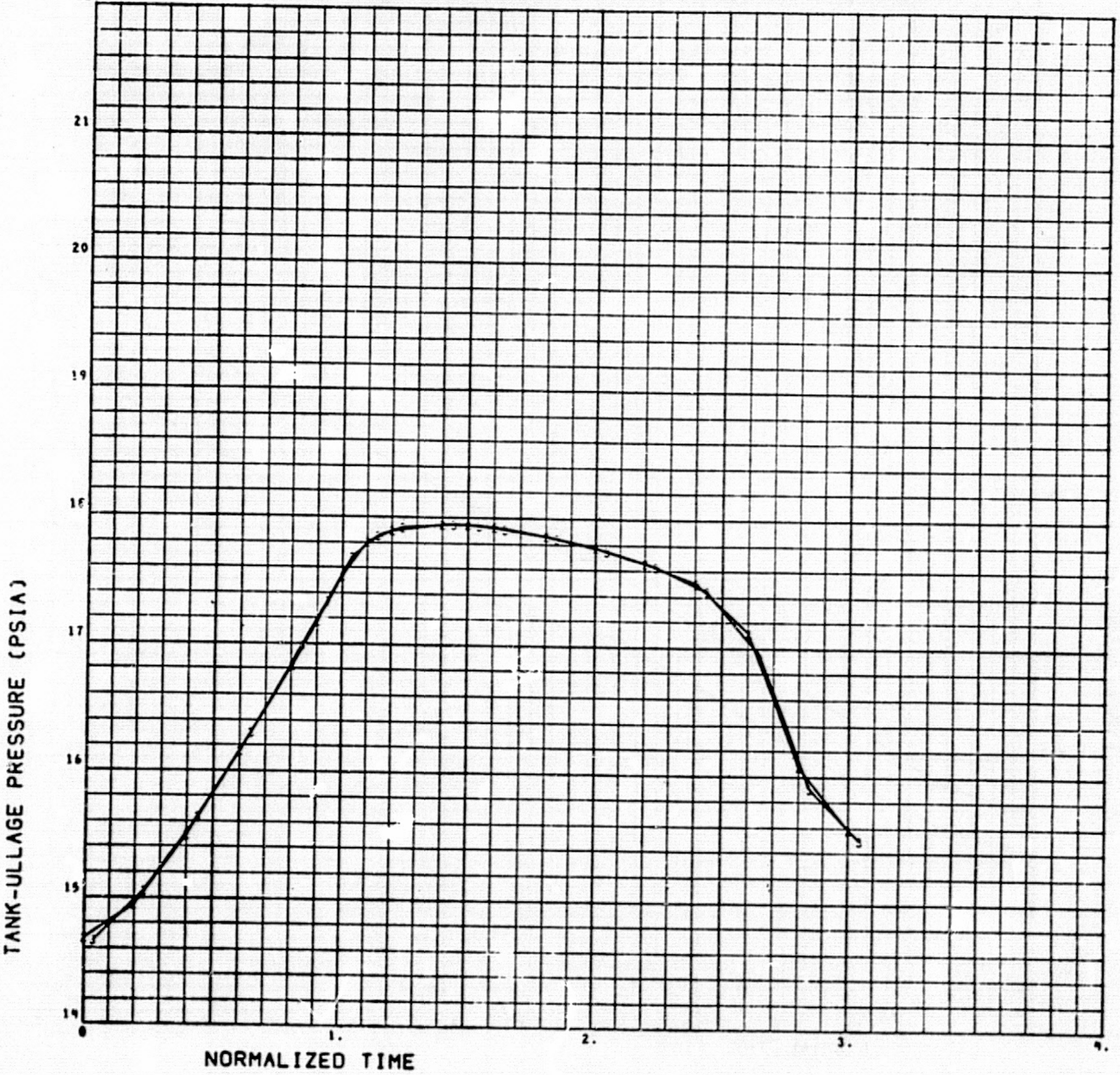
12 IN. TNK TST1G32 BULK ULGE γ LIQ TEMP HISTORIES



1 - LIQUID

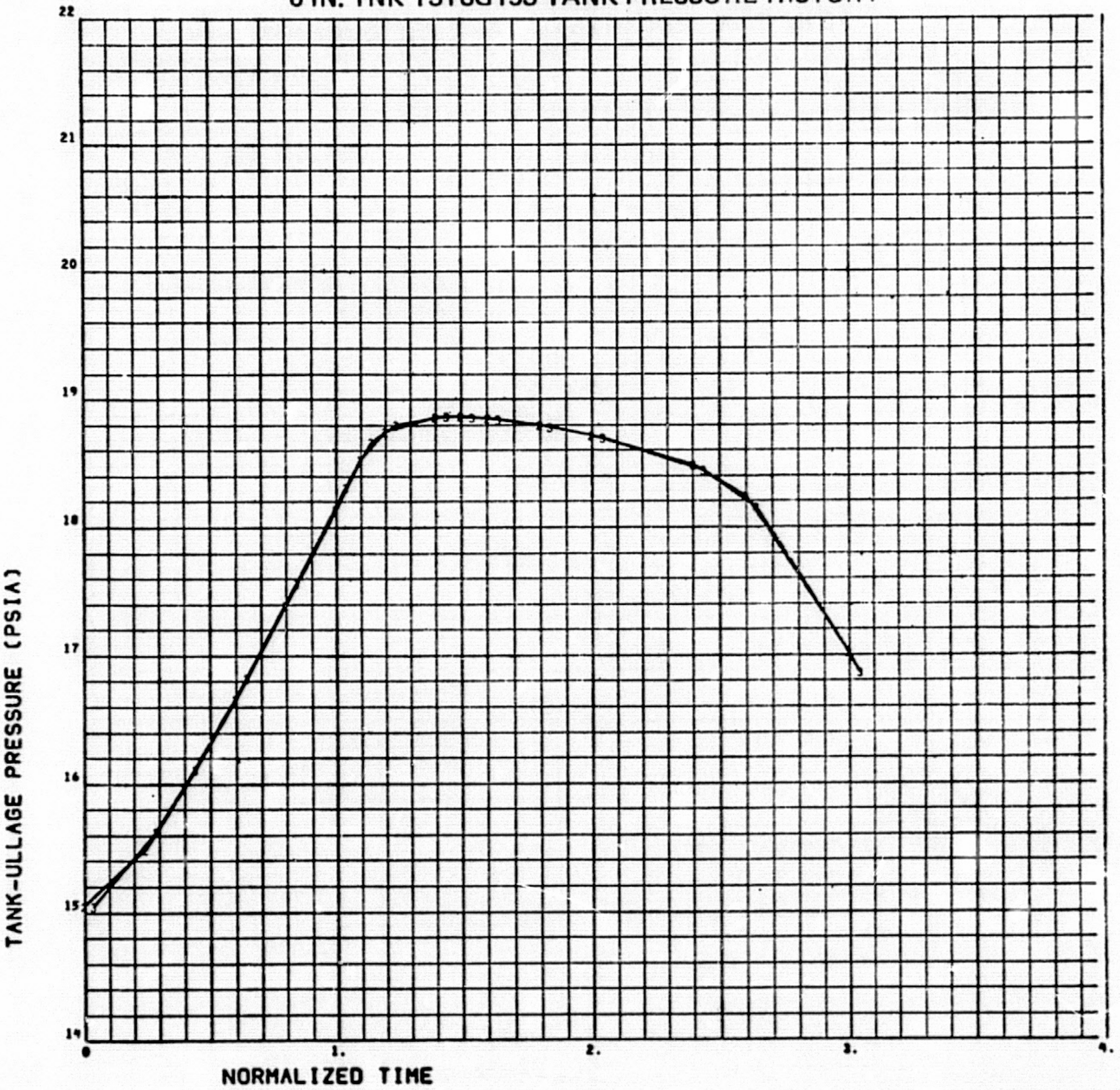
B - ULLAGE

FIGURE 5.3-5a
6 IN. TNK TEST 8GΣ9S – TANK PRESSURE HISTORY



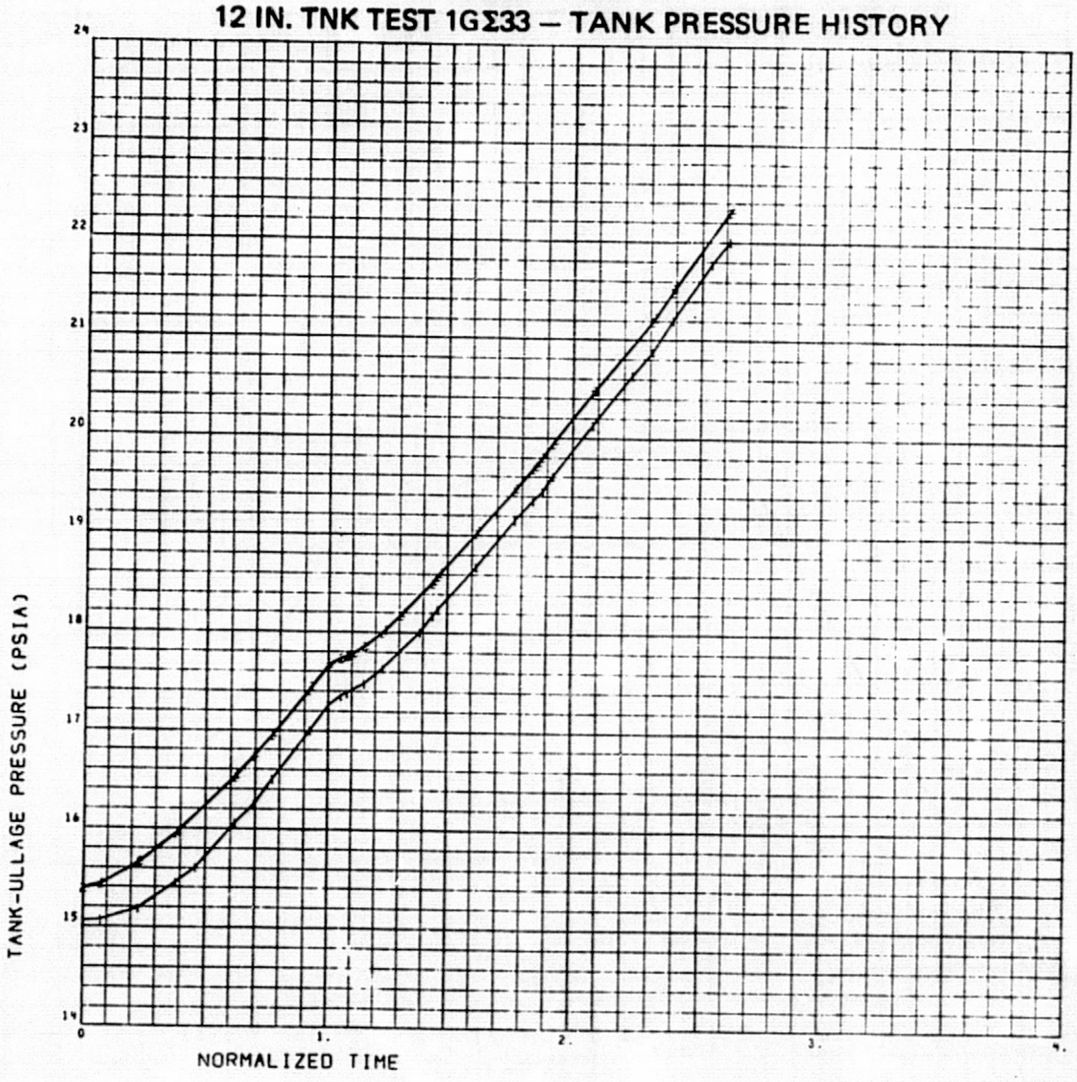
2
3 } Pressure - Transducer

FIGURE 5.3-5b
6 IN. TNK TST8G15S TANK PRESSURE HISTORY



2- Transducer Measured
3-

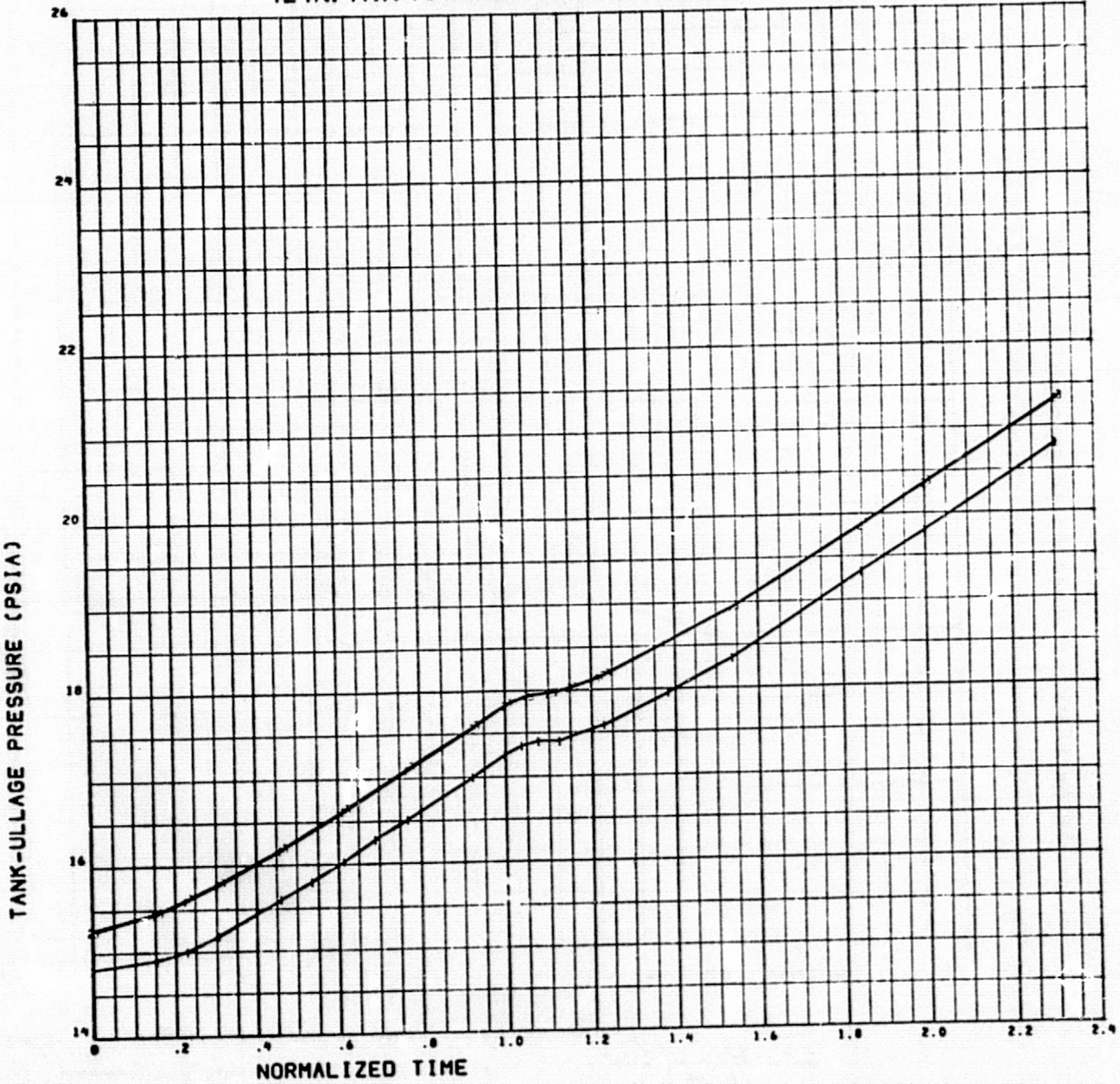
FIGURE 5.3-5c
12 IN. TNK TEST 1GΣ33 – TANK PRESSURE HISTORY



1 - GAGE
2 }
3 } - TRANSDUCER

FIGURE 5.3-5d

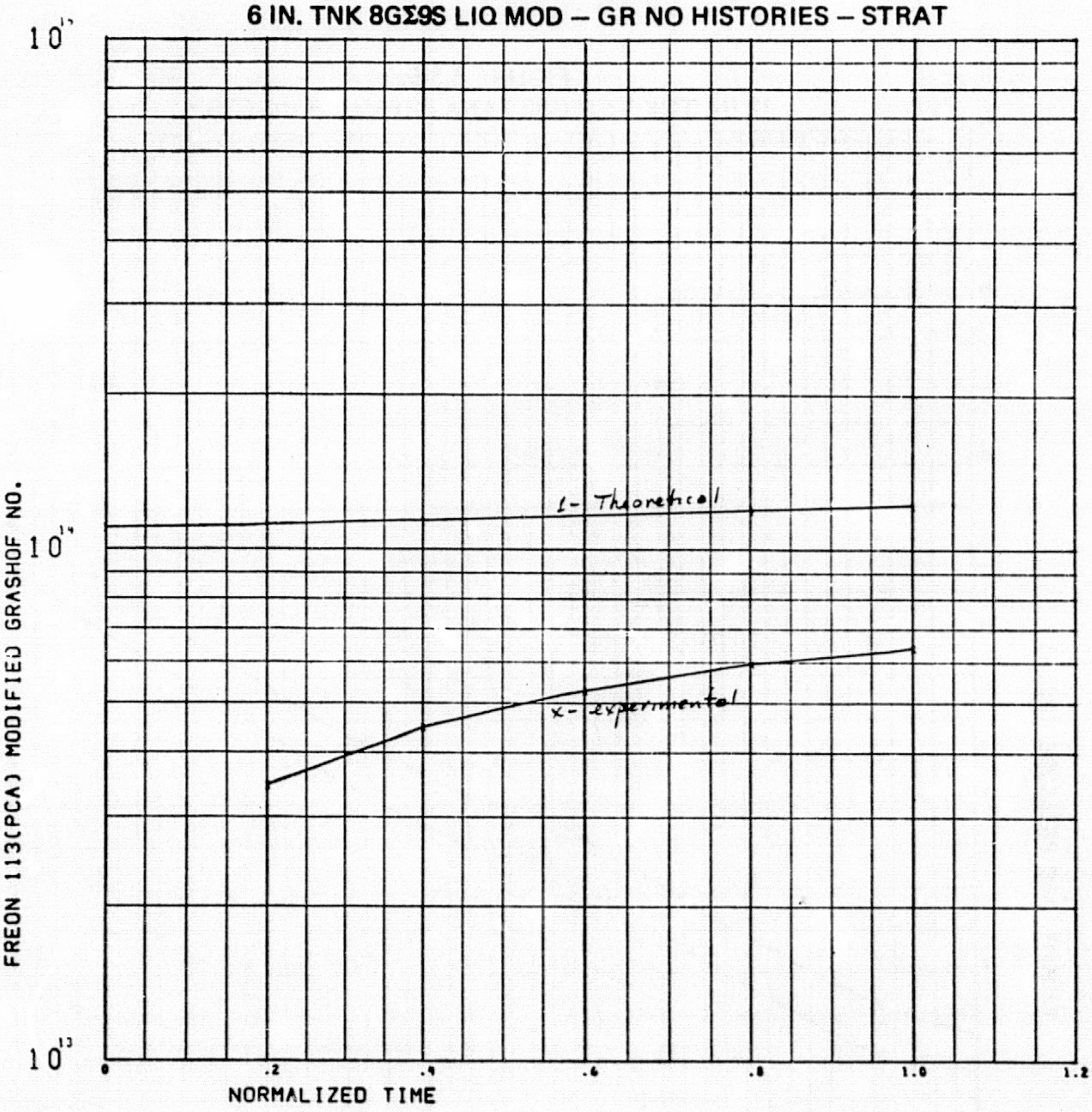
12 IN. TNK TST1G32 TANK PRESSURE HISTORY



1 - Gaga measured
2 - Transducer Measured
3 -

FIGURE 5.3-6a

6 IN. TNK 8GΣ9S LIQ MOD – GR NO HISTORIES – STRAT



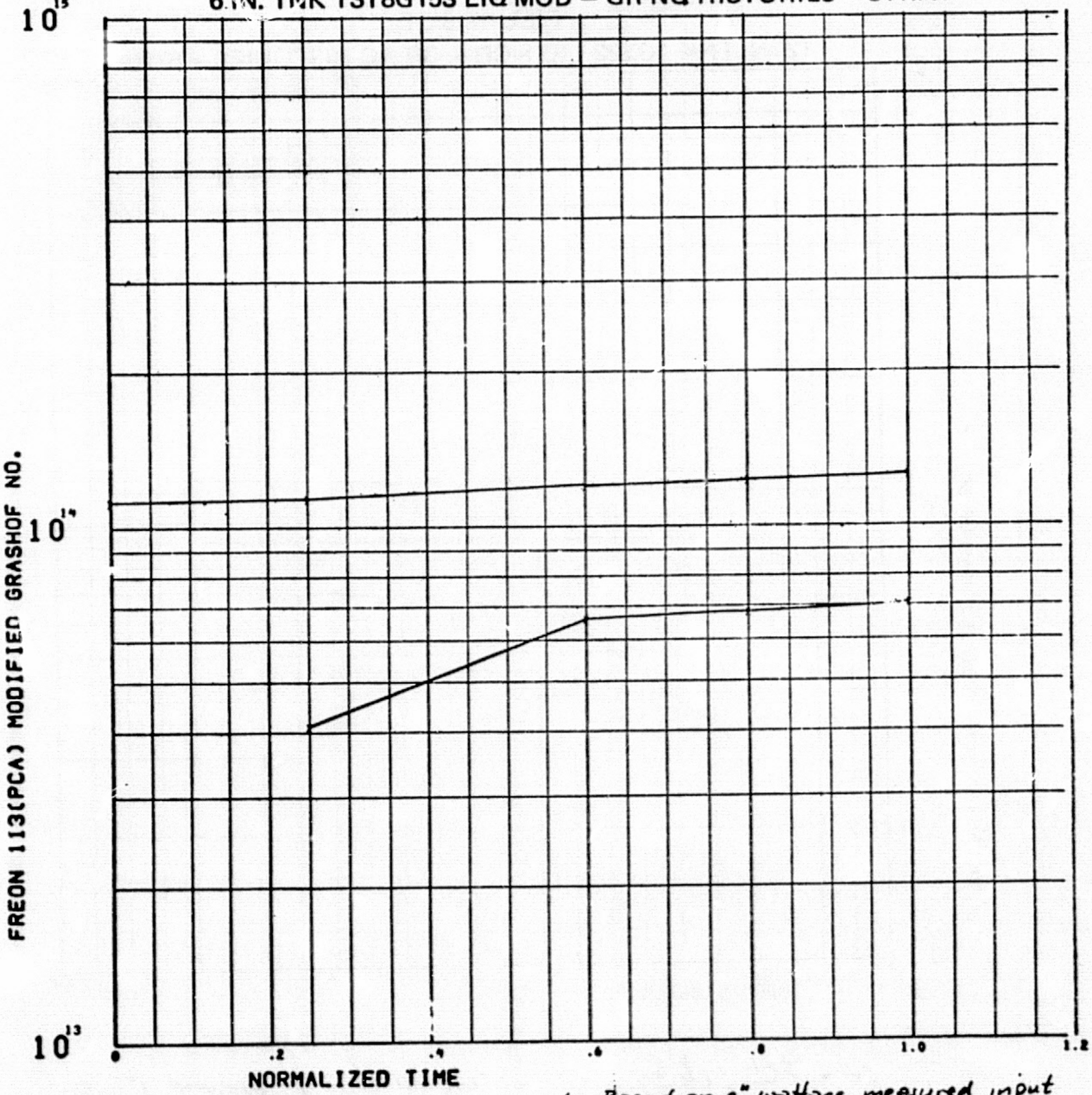
$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2}\left(\frac{q''L}{k}\right)$$

1 .... Based on measured wattage; q''_H input
x ... " " experimentally determined; q''_{liquid}

L = Liquid (Freon PCA (113)) depth

FIGURE 5.3-6b

6 IN. TNK TST8G15S LIQ MOD – GR NQ HISTORIES – STRAT



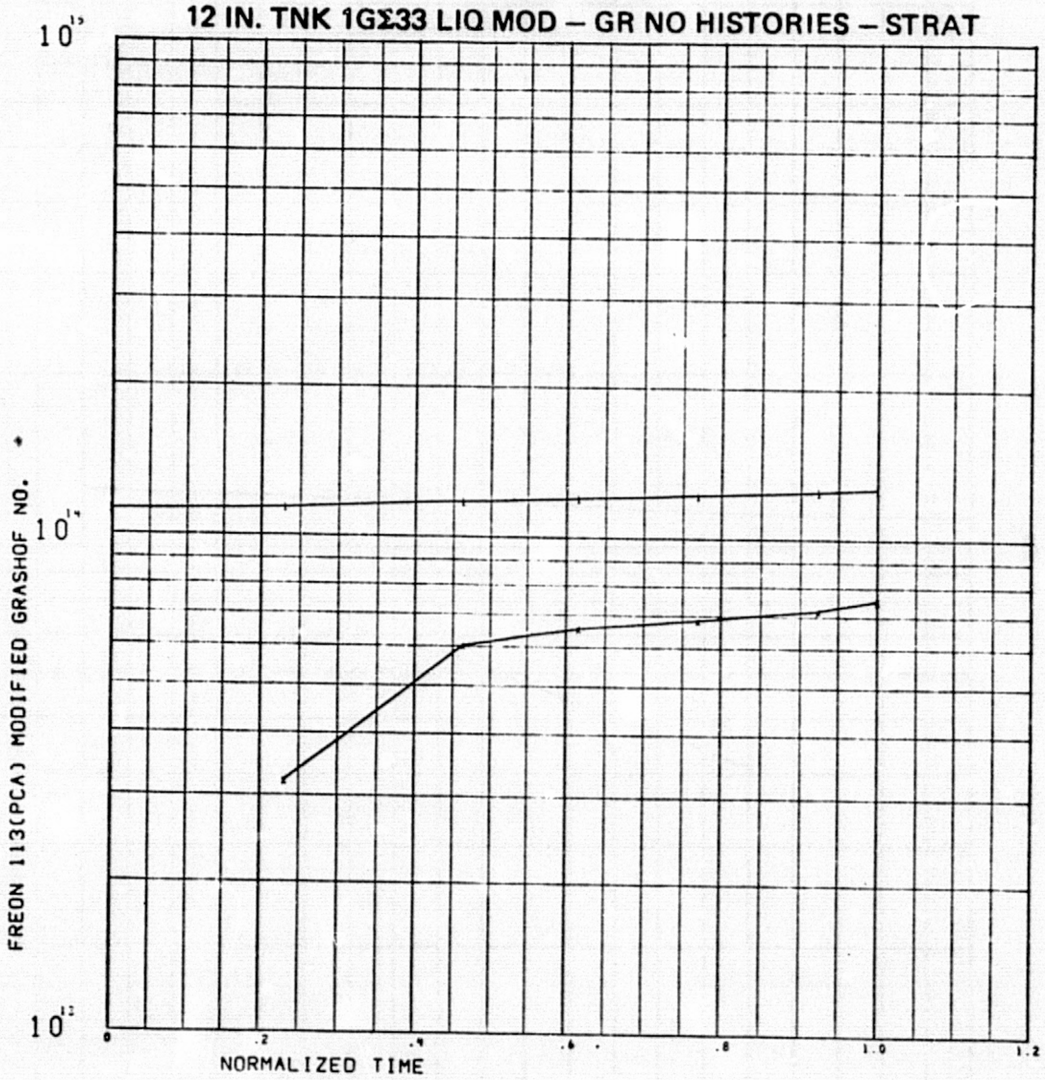
$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

L = Fluid depth

1 - Based on q''_H wattage measured input

2 - Based on experimentally absorbed q''_{fluid}

FIGURE 5.3-6c
12 IN. TNK 1GΣ33 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g \beta L^3}{(\mu/\rho)_l^2} \left(\frac{q'' L}{k_l} \right)$

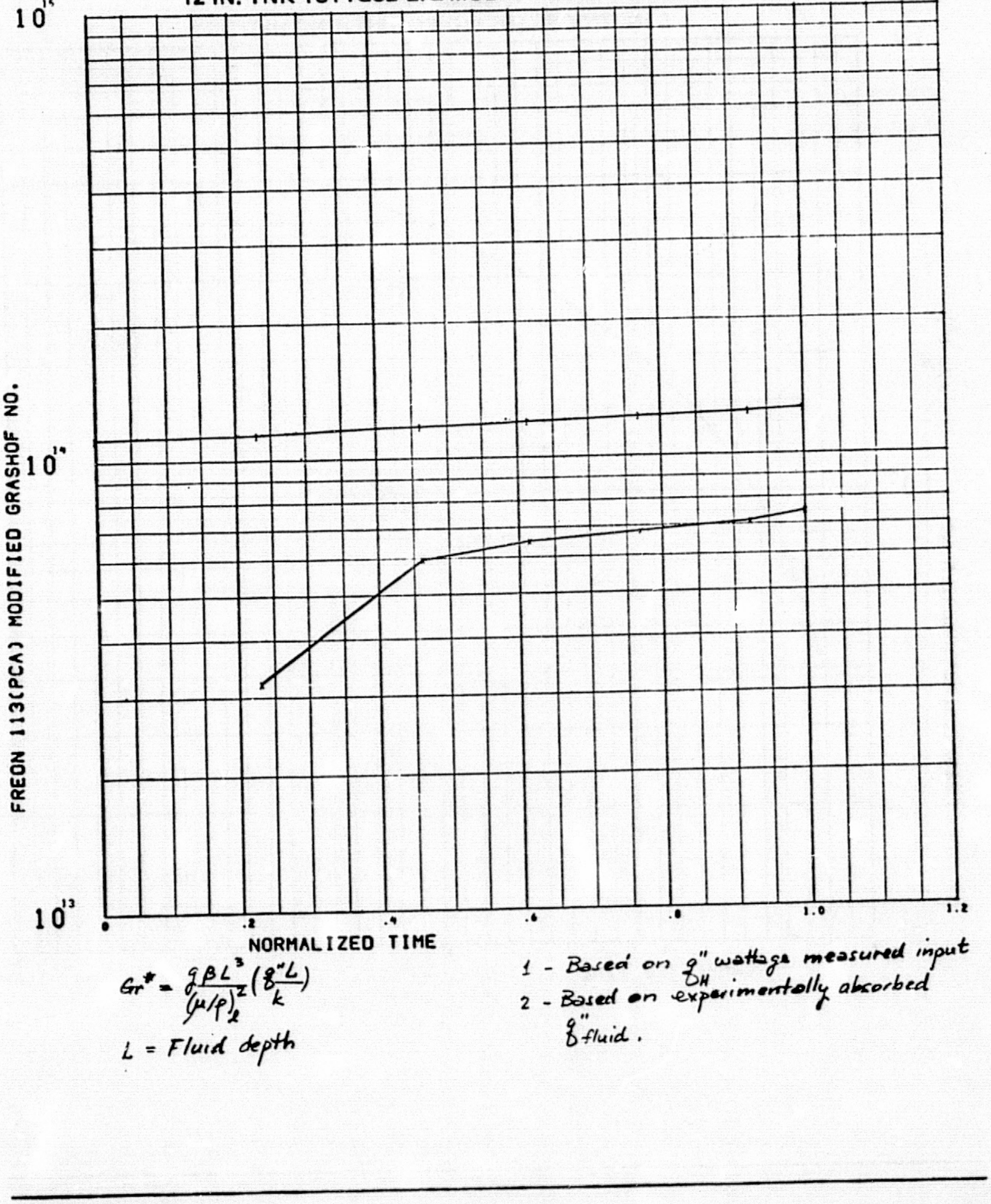
L = Fluid depth

1 – Theoretical based on measured $q''_{\text{wattage input}}$

X – Experimental based on measured q''_{fluid}.

FIGURE 5.3-6d

12 IN. TNK TST1G32 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

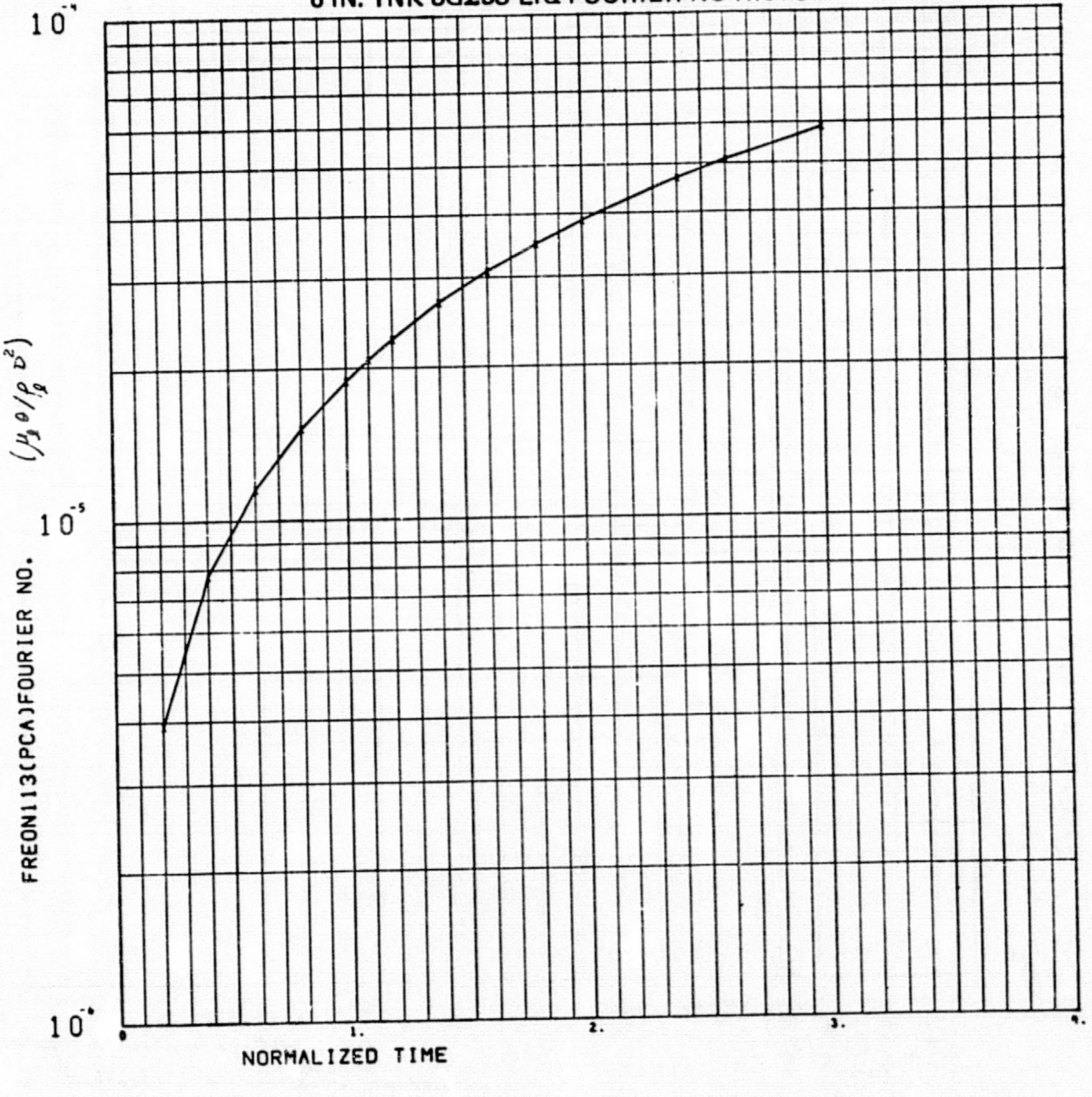
L = Fluid depth

1 - Based on q''_H wattage measured input

2 - Based on experimentally absorbed q''_{fluid}.

FIGURE 5.3-7a

6 IN. TNK 8GΣ9S LIQ FOURIER NO HISTORY



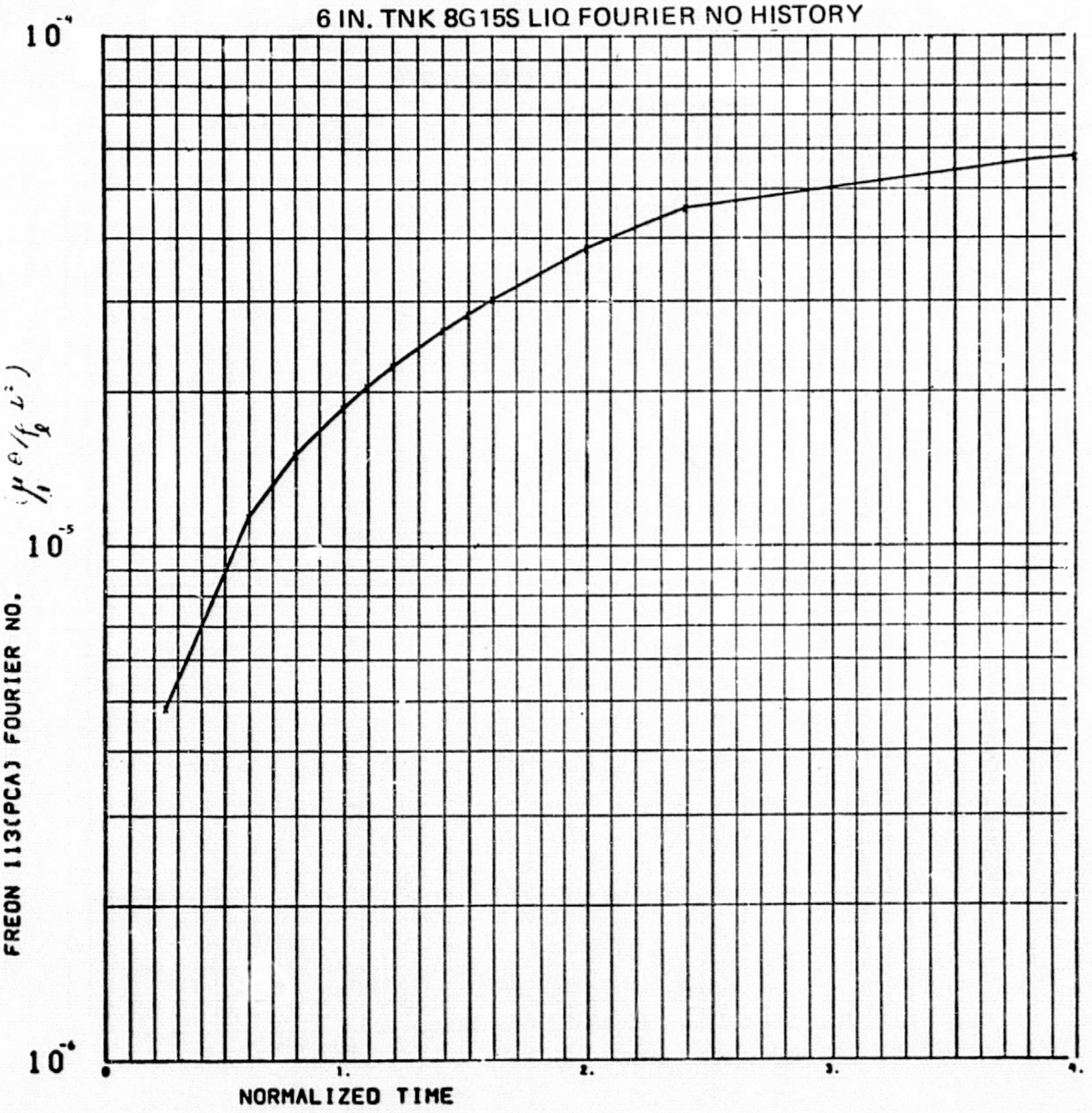


FIGURE 5.3-7b
6 IN. TNK 8G15S LIQ FOURIER NO HISTORY

FIGURE 5.3-7c
12 IN. TNK 1GΣ33 LIQ FOURIER NO HISTORY

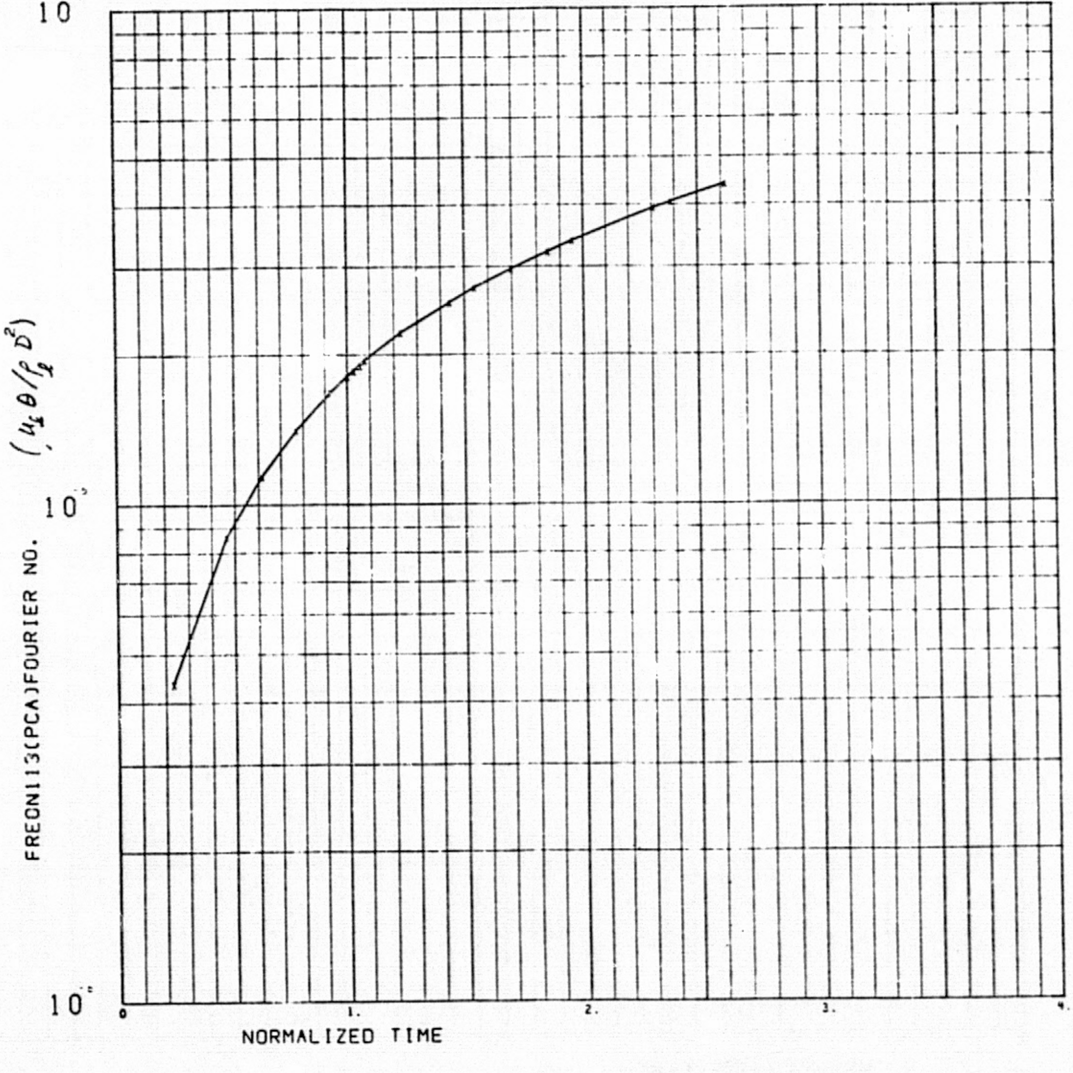
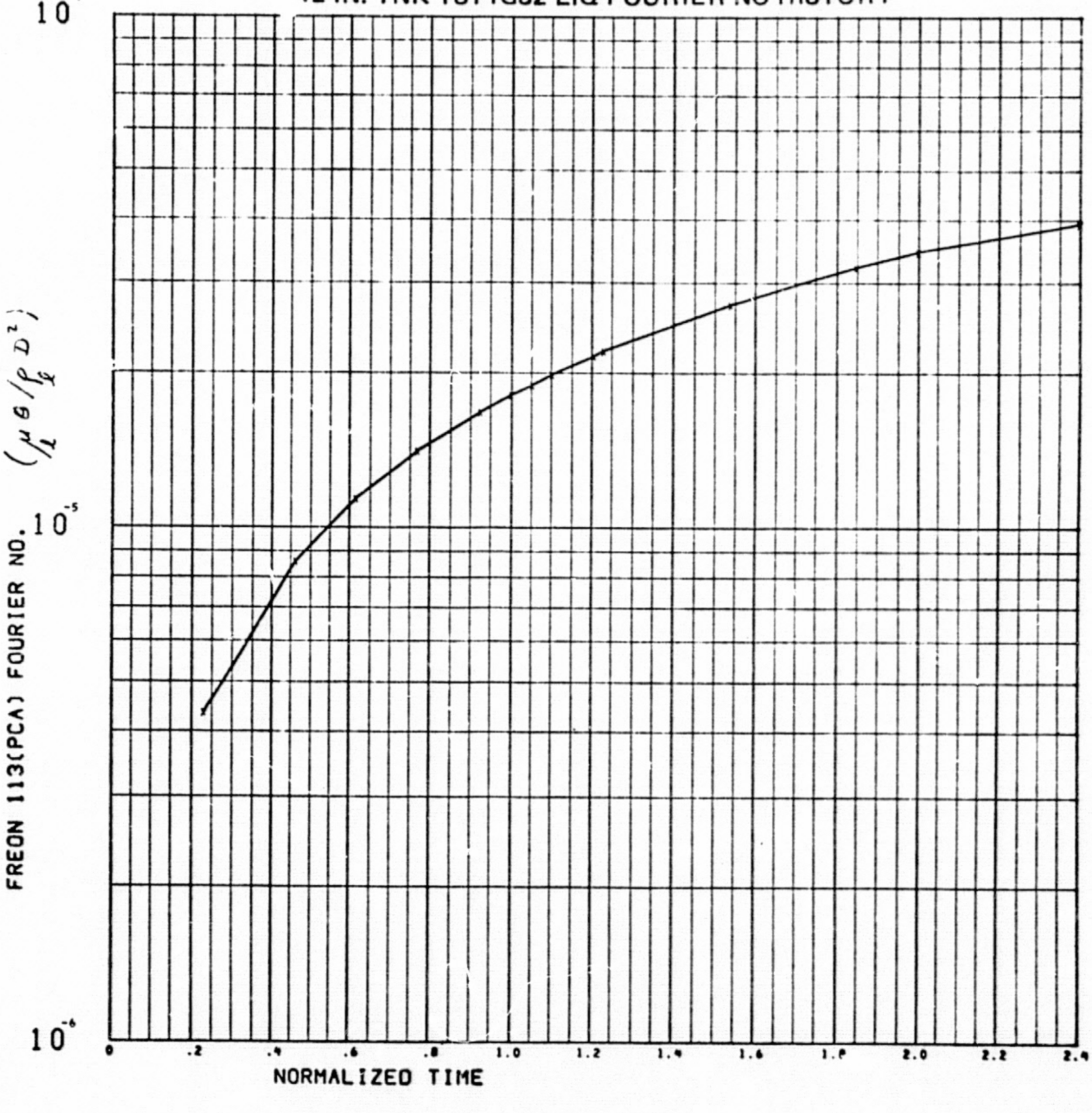


FIGURE 5.3-7d

12 IN. TNK TST1G32 LIQ FOURIER NO HISTORY



Section 5.4

SCALING SET

6-in. -Dia Tank Tests	12-in. -Dia Tank Tests
8G	1G
Test #16S Test #10S	Test #34 Test #35

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Table 5.4-1a. 6 IN. DIA. TANK TEST 8G#16S (Page 1 of 2)

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

  DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708        FLNGE AREA FT2=    .0365
 DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=   .00164      FLNGE VOL FT3=     .00076
 DME MASS LBM=    .65596      MASS 1/2 CYL LBM=    .81996      FLANGE MASS=    .38058

  LIQ VOL FT3=    .13090       ULLAGE VOL FT3=    .13090

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES -

 H12= 701.5691   H34= 701.5691   H56= 701.5691   H910= 701.5691   H78= 701.5691

 EST.HT FLUX IN LIQ (BTU/HR-FT2)= 701.5691
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)= 701.5691
 EST.HT INPUT LIQ(STRAT)BTU=    32.142       (STRAT+DESTRAT)BTU=     0.000
 EST.LIQ TEMP INCRSE(STRAT)=    11.5470F       (STRAT+DESTRAT)=     0.0000F

 EST.HT INPUT ULLAGE(STRAT)BTU=    32.142       (STRAT+DESTRAT)BTU=     0.000
```

Table 5.4-1b. 6 IN. DIA. TANK TEST 8G#10S

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

  DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708        FLNGE AREA FT2=    .0365
 DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=   .00164      FLNGE VOL FT3=     .00076
 DME MASS LBM=    .65596      MASS 1/2 CYL LBM=    .81996      FLANGE MASS=    .38058

  LIQ VOL FT3=    .13090       ULLAGE VOL FT3=    .13090

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12= 701.5691   H34= 701.5691   H56= 701.5691   H910= 701.5691   H78= 701.5691

 EST.HT FLUX IN LIQ (BTU/HR-FT2)= 701.5691
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)= 701.5691
 EST.HT INPUT LIQ(STRAT)BTU=    32.142       (STRAT+DESTRAT)BTU=     0.000
 EST.LIQ TEMP INCRSE(STRAT)=    11.5474F       (STRAT+DESTRAT)=     0.0000F

 EST.HT INPUT ULLAGE(STRAT)BTU=    32.142       (STRAT+DESTRAT)BTU=     0.000
```

Table 5.4-1c. 12 IN. DIA. TANK TEST 1G#34 (Page 2 of 2)

```
      STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

  DOME AREA FT2=  1,5708        CYL AREA FT2=  6,2832        FLNGE AREA FT2=    ,1458
DME WALL VOL FT3=    ,01047      1/2 CYL WALL VOLFT3=    ,01309     FLNGE VOL FT3=    ,00608
DME MASS LBM=  5,24772        MASS 1/2 CYL LBM=  6,55965     FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,04720        ULLAGE VOL FT3=  1,04720

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 350,3504   H34= 350,3504   H56= 349,4822   H910= 350,3504   H78= 350,3504

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 349.7716
EST,HT FLUX IN ULLGE (BTU/HR-FT2)= 350,3504
EST,HT INPUT LIQ(STRAT)BTU=  247,239       (STRAT+DESTRAT)BTU=  366,271
EST,LIQ TEMP INCRSE(STRAT)=   11,1007F       (STRAT+DESTRAT)=    15,4362F

EST,HT INPUT ULLAGE(STRAT)BTU=  247,648      (STRAT+DESTRAT)BTU=  366,877
```

Table 5.4-1d. 12 IN. DIA. TANK TEST #35

```
      STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

  DOME AREA FT2=  1,5708        CYL AREA FT2=  6,2832        FLNGE AREA FT2=    ,1458
DME WALL VOL FT3=    ,01047      1/2 CYL WALL VOLFT3=    ,01309     FLNGE VOL FT3=    ,00608
DME MASS LBM=  5,24772        MASS 1/2 CYL LBM=  6,55965     FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,04720        ULLAGE VOL FT3=  1,04720

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 350,3504   H34= 350,3504   H56= 349,4822   H910= 350,3504   H78= 350,3504

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 349,7716
EST,HT FLUX IN ULLGE (BTU/HR-FT2)= 350,3504
EST,HT INPUT LIQ(STRAT)BTU=  247,239       (STRAT+DESTRAT)BTU=  476,163
EST,LIQ TEMP INCRSE(STRAT)=   11,1019F       (STRAT+DESTRAT)=    21,3619F

EST,HT INPUT ULLAGE(STRAT)BTU=  247,648      (STRAT+DESTRAT)BTU=  476,951
```

Table 5.4-2a. 6 IN. DIA TANK TEST 8G #16S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.333	.667	1.333	1.667	2.000	2.333
TAU	0.000	.143	.286	.571	.714	.857	1.000
1	116.333	118.042	123.125	135.458	142.167	148.958	156.125
2	116.542	122.667	137.125	164.667	177.667	189.708	201.208
3	116.625	121.583	134.208	161.792	175.625	188.792	201.458
4	116.917	122.792	136.333	162.667	174.500	184.917	194.708
5	116.708	120.833	126.167	132.458	135.458	138.042	140.958
6	116.875	121.250	126.583	131.917	133.750	135.542	137.500
7	117.000	121.479	126.333	130.750	133.125	134.917	136.750
8	117.125	121.708	126.083	129.583	132.500	134.292	136.000
9	116.083	117.875	119.917	122.292	123.542	124.917	126.500
10	116.167	128.458	144.375	174.333	188.292	201.583	214.292
11	116.250	129.000	145.292	173.875	186.458	197.792	208.208
12	117.458	126.375	130.708	135.292	137.250	138.917	140.542
13	116.750	125.000	129.042	131.667	132.917	133.958	135.292
14	115.917	117.708	120.542	131.750	137.042	142.208	147.875
15	116.167	120.917	131.000	153.417	164.583	175.417	186.083
16	116.250	121.875	132.583	154.167	164.542	174.167	183.667
17	116.708	122.844	130.615	143.885	150.021	155.698	161.344
18	115.708	119.875	123.333	126.875	128.750	130.417	131.375
19	115.208	116.458	118.167	120.750	122.042	123.125	124.542
20	116.167	128.458	144.375	174.333	188.292	201.583	214.292
21	116.250	129.000	145.292	173.875	186.458	197.792	208.208
22	117.458	126.375	130.708	135.292	137.250	138.917	140.542
23	116.750	125.000	129.042	131.667	132.917	133.958	135.292
24	116.292	129.917	143.875	168.333	179.125	189.208	199.000
25	116.000	117.958	120.708	126.458	129.625	133.750	139.583
26	116.021	117.833	120.417	125.958	128.854	132.271	136.583
27	116.042	117.708	120.125	125.458	128.083	130.792	133.583
28	116.417	119.292	122.792	132.250	137.750	143.875	150.375
29	116.083	123.458	130.583	144.333	151.125	157.917	164.667
30	116.542	134.667	152.500	183.042	196.417	208.583	220.417
31	117.014	124.764	128.083	129.500	129.750	130.458	131.694
32	117.625	125.375	129.000	130.167	130.417	131.042	132.083
33	115.083	117.000	119.000	121.167	121.708	122.250	123.167
34	112.000	112.708	113.625	115.583	116.375	117.083	118.000

Table 5.4-2a. 6 IN. DIA TANK TEST 8G #16S (Page 2 of 2)

35	108.250	108,583	109,125	110,292	110,833	111,542	112,417
36	116.708	124,458	127,625	129,167	129,417	130,167	131,500
37	116,583	120,042	124,458	140,458	149,333	158,208	167,792
38	116,667	118,458	121,917	129,458	140,792	149,417	158,000
39	116,792	118,583	121,333	128,833	133,750	143,000	149,125
40	117,042	118,792	122,708	130,208	135,125	140,375	145,958
41	116,667	118,500	121,125	128,292	131,708	136,042	142,250
42	116,917	118,792	121,958	130,875	137,000	146,375	154,042
43	117,125	118,792	122,375	130,458	134,792	145,167	152,167
44	117.375	119,083	122,083	129,292	137,375	145,208	153,458
45	117.083	119,083	122,542	130,542	138,083	145,792	154,500
46	116,833	119,667	123,042	132,583	142,292	151,333	161,000
47	117.542	122,500	129,042	147,292	157,750	167,917	178,792
48	116,396	118,104	121,375	129,021	132,604	136,708	145,833
49	116,125	117,708	121,625	129,750	133,500	137,375	149,417
50	116,667	118,042	120,917	128,750	132,500	136,375	146,958
51	116,417	117,917	120,833	127,917	132,167	136,167	147,917
52	117,063	118,708	121,521	128,125	132,083	136,000	144,458
53	116,083	117,750	120,375	128,708	133,792	137,417	147,792
54	117.708	119,500	122,208	128,333	132,000	135,833	141,000
55	117,583	119,292	122,875	130,458	134,333	139,917	148,917
56	117.708	119,500	122,208	128,333	132,000	135,833	141,000
57	117.583	119,292	122,875	130,458	134,333	139,917	148,917
58	116,292	117,958	120,750	128,625	132,875	136,708	144,917
59	117,292	119,167	121,667	128,333	131,958	135,250	139,625
60	118,708	120,583	123,208	128,500	131,417	133,875	136,833
61	116,042	117,042	118,625	122,292	124,667	125,833	128,333
62	116,083	116,875	118,625	121,250	123,125	124,583	126,458
63	117,125	117,708	120,000	122,625	124,875	126,083	127,792
64	118,333	118,042	120,292	122,458	123,792	124,500	126,792
65	115,917	115,750	116,708	119,042	120,583	121,875	123,500
66	116,083	115,875	116,458	118,250	119,167	119,833	121,292
67	116,833	116,625	117,292	119,208	120,125	120,667	122,250
68	117,917	117,625	117,958	118,625	119,833	120,458	122,000
69	115,792	115,583	116,042	116,792	118,000	118,542	119,833
▼ 70	115,917	115,750	116,250	117,042	117,625	118,500	120,042
71	116,333	116,417	116,750	117,583	118,375	119,042	120,458
72	116,958	117,583	118,375	119,208	120,167	121,208	122,542
73	115,042	116,000	117,292	118,000	118,708	119,833	121,042
74	108,917	109,208	110,333	112,917	115,167	117,333	120,542
75	95,917	96,125	96,792	97,708	98,417	98,875	100,167
76	105,208	105,167	105,458	105,917	106,500	106,792	107,667
77	91,208	91,125	91,208	90,958	90,792	90,708	90,917

Table 5.4-2b. 6 IN. DIA TANK TEST 8G #10S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.333	.666	1.000	1.333	1.666	2.000	2.333
TAU	0.000	.143	.285	.429	.571	.714	.857	1.000
1	116.500	118.417	120.917	125.000	131.083	136.333	141.583	146.667
2	117.500	124.792	139.250	153.583	167.042	179.833	190.917	201.042
3	117.833	123.125	135.625	149.458	163.000	176.250	188.792	200.417
4	117.833	123.917	136.708	149.875	162.375	173.792	184.292	193.792
5	117.250	121.167	126.083	129.417	132.583	135.583	138.250	140.792
6	117.542	121.500	126.458	129.667	131.833	133.667	135.625	137.083
7	117.625	121.917	126.563	128.792	130.604	132.896	134.750	136.000
8	117.708	122.333	126.667	127.917	129.375	132.125	133.875	134.917
9	116.333	118.000	119.875	121.000	122.042	123.458	124.792	125.958
10	116.792	129.333	144.250	159.417	173.375	186.792	199.583	211.333
11	117.000	130.125	145.667	160.333	173.375	185.208	196.083	205.792
12	117.917	126.667	130.542	133.083	135.125	137.083	138.625	139.917
13	117.250	125.167	128.792	130.667	131.458	132.500	133.667	134.792
14	116.500	118.417	120.917	125.000	131.083	136.333	141.583	146.667
15	116.750	121.708	131.417	142.333	153.083	164.000	174.500	184.125
16	117.042	122.625	133.125	144.250	154.833	165.083	174.625	183.542
17	117.542	121.500	126.458	129.667	131.833	133.667	135.625	137.083
18	116.375	120.042	123.542	125.208	126.917	128.917	130.167	131.083
19	115.750	116.917	118.250	119.708	120.625	122.000	123.208	124.375
20	116.792	129.333	144.250	159.417	173.375	186.792	199.583	211.333
21	117.000	130.125	145.667	160.333	173.375	185.208	196.083	205.792
22	117.917	126.667	130.542	133.083	135.125	137.083	138.625	139.917
23	117.250	125.167	128.792	130.667	131.458	132.500	133.667	134.792
24	116.792	128.083	140.875	153.583	165.167	176.250	186.583	195.792
25	116.583	118.750	121.375	124.417	127.333	130.500	133.708	136.875
26	116.563	118.583	121.063	124.021	126.813	129.792	132.896	135.875
27	116.542	118.417	120.750	123.625	126.292	129.083	132.083	134.875
28	116.917	119.542	122.667	127.000	131.875	137.458	143.458	149.583
29	116.500	122.542	129.167	135.958	142.667	149.542	156.417	163.000
30	116.792	132.208	148.458	164.583	179.167	192.792	205.125	216.458
31	116.667	124.042	127.063	128.979	129.354	129.792	130.313	131.083
32	117.167	124.375	127.417	129.625	130.042	130.333	130.833	131.500
33	115.208	116.667	118.542	120.167	120.917	121.542	122.167	122.792
34	113.208	113.458	114.333	115.167	115.792	116.708	117.375	117.833

Table 5.4-2b. 6 IN. DIA TANK TEST 8G #10S (Page 2 of 2)

35	111.458	111.333	111.458	111.708	111.750	112.167	112.625	112.708
36	116.167	123.708	126.708	128.333	128.667	129.250	129.792	130.667
37	117.542	120.708	125.500	133.083	141.083	149.583	158.125	166.917
38	117.792	119.708	122.625	126.833	133.542	142.042	149.792	157.583
39	117.708	119.250	121.917	125.917	130.125	136.542	143.042	149.708
40	118.125	119.667	122.792	127.000	130.500	135.417	139.958	145.083
41	117.833	119.292	121.875	124.875	128.417	131.875	135.958	140.625
42	118.458	119.625	123.042	127.333	131.708	138.458	146.625	154.625
43	118.333	119.750	122.958	126.667	130.292	135.333	144.042	151.833
44	118.583	120.083	122.792	126.667	130.708	138.917	146.167	152.333
45	118.542	119.917	123.000	127.250	131.417	139.625	146.583	154.375
▼ 46	117.958	120.875	124.292	128.917	134.792	145.042	153.042	161.208
47	118.708	123.333	129.792	138.625	147.625	157.917	167.292	177.708
48	118.917	120.333	123.375	126.958	130.958	134.875	139.250	148.458
49	117.000	118.708	121.375	123.667	127.333	133.958	138.667	147.917
50	117.417	119.208	121.792	125.458	129.250	132.958	137.083	144.917
51	116.542	118.750	121.250	124.875	128.917	133.208	139.208	148.375
52	117.833	119.646	122.063	125.354	129.104	132.854	137.563	144.250
53	116.833	118.500	121.583	125.417	129.917	133.875	140.333	149.917
54	119.125	120.542	122.875	125.833	129.292	132.500	135.917	140.125
55	118.708	120.417	123.250	127.208	131.333	135.167	139.667	148.208
56	119.125	120.542	122.875	125.833	129.292	132.500	135.917	140.125
57	118.708	120.417	123.250	127.208	131.333	135.167	139.667	148.208
58	116.792	118.792	121.333	125.167	129.375	133.000	137.542	141.792
59	117.958	119.958	122.458	125.333	129.208	132.333	136.583	140.208
60	119.375	121.500	124.083	126.708	129.667	132.417	135.458	138.292
61	115.958	117.250	118.958	120.875	121.917	124.042	126.833	129.083
62	116.292	116.917	118.667	119.917	121.292	123.292	124.833	126.208
63	117.250	117.708	119.917	121.000	123.042	124.625	126.708	127.750
64	118.375	118.708	120.375	121.208	122.792	123.250	124.667	126.333
65	115.792	116.042	116.417	117.833	118.792	119.958	121.875	123.000
66	115.958	116.292	116.125	116.917	118.083	118.792	120.292	120.792
67	116.917	117.250	116.958	118.000	119.167	119.875	120.833	121.750
68	117.917	118.000	118.333	118.250	119.042	119.667	120.958	121.792
69	115.542	115.833	115.750	116.083	116.958	117.500	118.875	119.292
70	115.667	116.042	115.917	116.458	117.208	117.542	118.583	119.333
71	116.333	116.750	116.542	117.208	117.625	118.250	119.458	120.167
72	117.292	117.917	118.167	118.708	119.667	119.958	121.125	121.708
73	114.875	116.250	116.833	117.958	118.250	118.417	119.458	120.125
74	108.708	109.542	110.208	111.417	113.208	115.083	117.625	120.125
75	95.083	95.583	95.750	96.375	97.000	97.667	98.583	99.208
76	104.500	104.708	104.583	104.833	105.292	105.625	106.292	106.708
77	89.125	89.417	89.125	89.083	89.167	88.833	89.167	88.833

Table 5.4-2c. 12 IN. DIA TANK TEST 1G #34 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	2,000	3,000	5,000	7,000	9,000
TAU	0,000	,222	,333	,556	,778	1,000
1	117,292	125,458	130,292	140,417	150,917	162,083
2	117,250	135,083	148,000	172,917	195,458	216,000
3	117,417	136,417	149,375	175,125	193,625	219,417
4	117,500	136,750	147,583	165,333	178,833	189,667
5	117,792	125,542	127,625	130,875	133,708	136,375
6	117,708	124,083	125,458	127,833	130,083	132,083
7	117,833	124,083	125,042	127,250	129,333	131,375
8	117,875	124,375	125,417	127,208	128,917	130,792
9	117,458	120,833	121,875	124,083	126,000	127,792
10	117,250	147,500	161,000	185,250	208,750	230,750
11	117,333	146,250	158,083	177,083	191,625	203,458
12	117,958	120,542	131,250	133,583	135,958	138,125
13	117,750	130,500	131,750	133,208	135,208	136,958
14	117,042	124,083	125,542	131,583	138,500	145,500
▼15	117,167	144,167	150,250	163,667	171,500	180,750
16	117,333	141,667	152,333	168,250	180,500	190,458
17	117,625	127,958	129,708	132,167	134,417	136,500
18	117,542	126,833	128,083	129,917	131,792	133,542
19	117,292	120,417	121,417	123,417	125,292	127,000
20	117,417	148,542	163,417	190,917	213,792	238,125
21	117,250	146,792	157,792	175,250	188,750	199,667
22	117,833	129,833	131,333	133,708	136,083	138,250
23	117,917	130,167	131,208	132,792	134,708	136,250
24	117,125	132,125	137,042	150,958	159,917	166,625
25	117,000	122,333	125,792	133,167	140,208	146,958
26	116,917	120,500	123,000	128,500	134,083	139,458
27	116,958	120,500	123,042	128,500	133,958	139,458
28	117,333	131,042	138,833	156,292	174,875	194,167
29	117,042	125,917	131,292	143,083	155,708	168,833
30	117,042	140,000	151,833	174,083	194,333	213,333
31	118,083	129,792	130,875	132,625	134,542	136,125
32	117,458	128,458	129,583	131,208	133,000	134,583
33	114,792	119,208	120,375	121,875	123,417	124,833
34	114,125	113,875	113,958	114,458	115,042	115,583

Table 5.4-2c. 12 IN. DIA TANK TEST 1G #34 (Page 2 of 2)

35	113,667	112,958	112,708	112,375	112,208	111,917
36	118,417	130,042	131,208	132,917	134,667	136,250
37	117,958	126,833	134,625	153,333	174,625	196,125
38	118,000	124,333	130,292	145,833	163,500	181,542
39	117,958	121,458	124,375	136,042	148,750	163,167
40	118,083	121,542	124,875	132,792	145,833	159,750
41	117,917	121,125	123,625	129,583	136,458	147,417
42	117,542	121,250	123,917	131,375	146,708	159,833
43	117,750	121,292	123,833	130,167	144,917	158,542
44	117,875	121,500	124,292	130,458	146,917	159,208
45	117,750	121,333	123,958	132,167	146,000	158,708
46	117,625	121,292	123,917	129,500	135,083	140,625
47	118,000	121,458	124,333	137,625	152,125	166,833
48	118,333	121,583	124,208	130,500	138,833	154,917
49	118,167	121,500	123,917	130,542	139,125	154,542
50	118,042	121,417	124,000	130,625	139,458	154,208
51	117,917	121,167	123,958	129,250	134,792	141,417
52	117,667	121,250	124,083	130,583	142,917	154,708
53	117,375	121,042	123,875	129,417	135,208	140,500
54	117,667	121,375	124,125	129,875	137,875	153,833
55	117,667	121,125	124,000	130,042	140,583	153,208
56	117,583	121,292	124,042	129,583	136,875	151,417
57	117,583	121,208	124,083	132,458	145,625	157,917
58	117,833	121,333	124,167	129,875	136,917	150,083
59	117,625	121,167	124,000	129,583	135,958	142,458
60	117,625	120,000	121,917	125,000	128,417	131,833
61	117,792	119,417	120,458	122,792	125,250	127,792
62	117,958	119,000	120,250	122,333	124,542	126,833
63	117,708	118,792	120,083	122,125	124,333	126,667
64	117,542	118,500	119,500	121,417	123,417	125,417
65	117,708	118,542	119,583	121,500	123,500	125,542
66	117,708	118,542	119,583	121,500	123,542	125,542
67	117,625	118,208	119,208	120,792	122,667	124,458
68	117,583	118,000	118,792	120,375	122,083	123,792
69	117,708	118,042	118,917	120,333	122,042	123,792
70	117,708	118,042	118,917	120,333	122,042	123,625
71	117,542	117,917	118,667	120,083	121,917	123,500
72	117,500	117,875	118,792	120,292	121,917	123,667
73	117,542	118,167	118,708	120,083	121,792	123,458
74	96,167	96,375	96,833	97,458	98,333	99,500
75	106,375	107,042	108,167	110,375	113,333	116,833
76	87,958	87,958	88,250	88,292	88,333	88,333
77	98,167	98,167	98,500	98,708	98,958	99,292

Table 5.4-2d. 12 IN. DIA TANK TEST 1G #35 (Page 1 of 2)

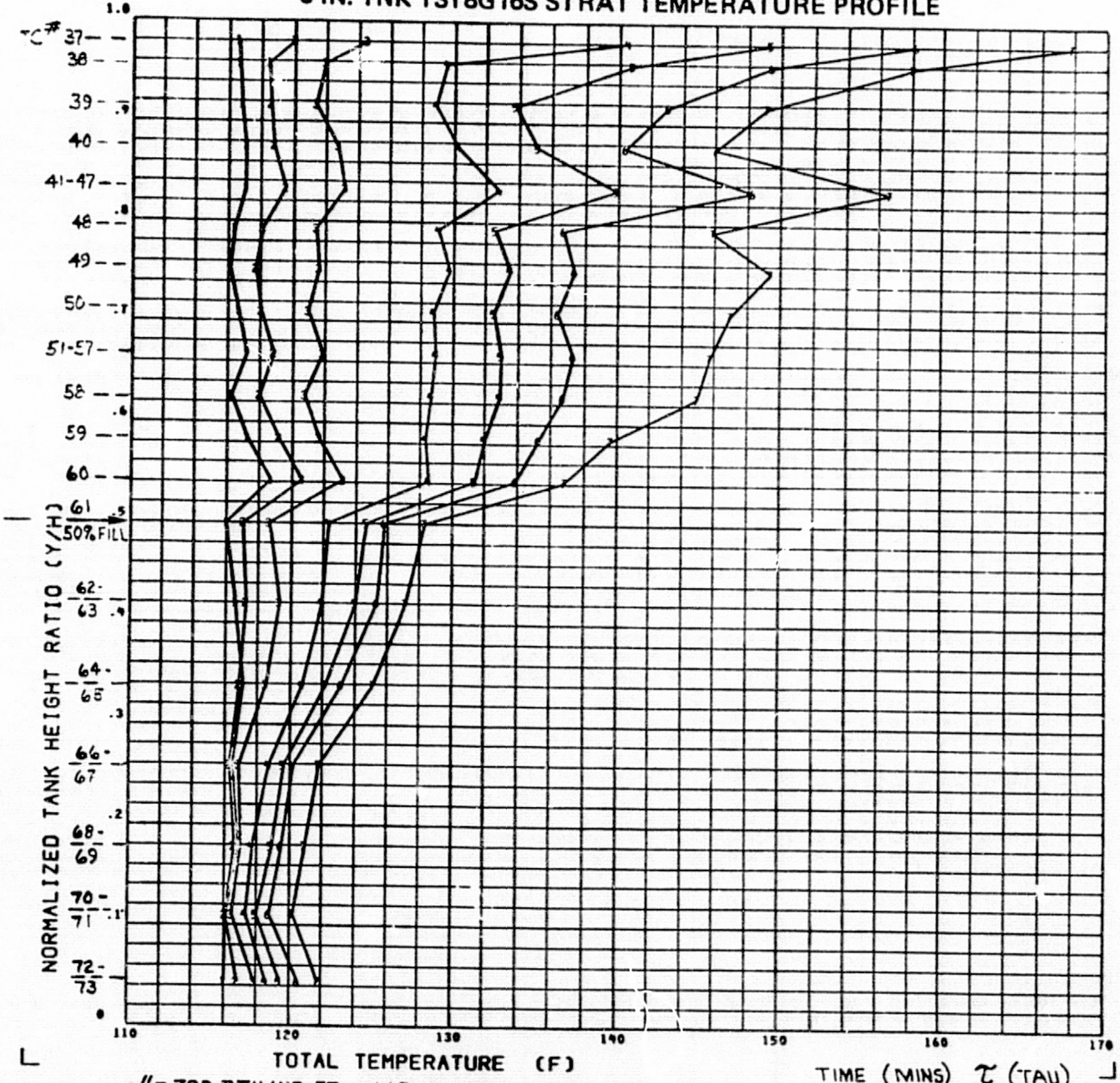
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	2.000	3.000	5.000	7.000	9.000
TAU	0.000	.222	.333	.556	.778	1.000
1	116,458	124.583	129,208	138.875	149,417	160,833
2	116,000	134.292	146,750	171.083	193,292	213,958
3	116,208	134.792	147,417	172.167	195,333	216,375
4	116,500	136.083	146,667	164.500	178,708	190,667
5	117,083	124,958	126,875	129.750	132,500	135,417
6	117,292	123.542	124,792	126.792	128,950	131.208
7	117,333	123.458	124,500	126.292	128,292	130,375
∇ 8	117,417	123.542	124,667	126.375	128,083	129.750
9	116,917	120.250	121,250	123.208	125,042	127,000
10	116,333	146.375	159,583	182.667	204,792	226,000
11	116,208	144,667	156,292	175.167	190,042	202,875
12	117,458	128.706	130,292	132.458	134,583	136,917
13	117,250	129,833	130,708	132.250	133,917	135,875
14	115,542	123.458	127,917	137.167	146,917	158,033
15	115,625	144.167	159,375	186.250	210,042	230,250
16	116,375	141.917	153,250	170.667	184,250	195,542
17	117,083	127,333	128,917	131.125	133,333	135,542
18	117,083	126,583	127,667	129.250	130,625	132,708
19	116,667	119.917	120,875	122.625	124,333	126,167
20	116,250	146.958	161,375	188.125	212,208	234,208
21	116,292	145,333	156,375	174.167	188,167	199,875
22	117,208	129.208	130,375	132,625	134,958	137,083
23	117,250	129,292	130,292	131.875	133,292	135,375
24	115,667	135.000	145,833	159.083	166,917	171,083
25	115,500	121.500	124,917	132.417	140,125	147,917
26	115,167	119.625	122,458	128.250	134,500	140,750
27	114,958	119.583	122,333	128.250	134,375	140,792
28	116,542	130.292	138,083	155.375	173,875	193,125
29	116,250	125.375	130,667	142.250	154,542	167,792
30	115,917	139.292	151,042	172.875	192,875	212,042
31	117.417	129.125	130,250	131.708	133,125	135,042
32	116,833	127,708	128,833	130.375	131,792	133,375
33	113,000	117.583	118,875	120.208	121,583	123,000
34	111,375	111.375	111,375	111.500	111,833	112,458

Table 5.4-2d. 12 IN. DIA TANK TEST 1G #35 (Page 2 of 2)

35	110.333	109.875	109,542	109.042	108,708	108.625
36	117.833	129.542	130,417	131.958	133,500	135,250
37	116,083	125.458	133,625	153.125	173,750	195.042
38	116.250	123.125	128,583	144.792	160.750	178.542
39	116,292	120.042	122,750	131.667	145,875	159.500
40	116,500	120.250	123,375	131.458	144,208	157,292
41	116,292	119,833	122,625	128.417	135,875	144,917
42	116,000	120.042	122,833	130.042	144,500	158,667
43	116,250	120.042	122,792	129.208	138,167	158,042
44	116,333	120,292	123,125	129.875	146,083	159,792
45	116,333	120.125	122,958	130.292	144,250	157,667
46	116,083	120.167	122,875	128.917	135,083	155.625
47	116.250	120,208	123,000	134.250	148,833	164,167
48	116,542	120.292	123,083	129.458	137,458	153,875
49	116,417	120.208	122,979	129.750	137,979	153,437
50	116,292	120.125	122,875	130.042	138,500	153,000
51	116,208	119,667	122,667	128.500	134,708	141,250
52	116,125	119,833	122,833	129.417	140,000	153,625
53	116,042	119,667	122,708	128.875	135,917	152,208
54	116,333	119.958	122,917	129.167	136,917	153,125
55	116,292	119.792	122,750	129,083	137,958	152,083
56	116,292	119,833	122,792	128.750	136,250	150,033
57	116,125	119.792	122,750	129.625	142,333	156,125
58	116,583	119.917	122,875	129,042	136,208	145,833
59	116,667	119,667	122,708	128.708	135,250	142,833
60	117,042	119.458	121,292	124.333	127,750	131,167
61	117,333	118.792	119,875	122.083	124,417	126,875
62	117,417	118.458	119,500	121.667	123,833	125,875
63	117,208	118.208	119,458	121.417	123,625	125,667
64	117,083	117,917	118,958	120.750	122,667	124.542
65	117,208	117.917	119,042	120.750	122,750	124.583
66	117,069	117,653	118,583	120.181	121,931	123,667
67	117,125	117,667	118,542	120.083	121,792	123,542
68	117.000	117.375	118,250	119.708	121,333	122,917
69	117,125	117.542	118,333	119.792	121,458	123,042
70	117,042	117.375	118,181	119.611	121,236	122,792
71	117,083	117.292	118,083	119.542	121,125	122,667
72	117,042	117.458	118,208	119.583	121,250	122,792
73	117,042	117.458	118,292	119.458	121,167	122,750
▼ 74	94,708	94.833	95,292	96.000	96,917	98,167
75	105,208	105.875	106,958	109.292	112,542	116,250
76	85,083	85.208	85,583	85.667	85,708	85,708
77	95,750	95.792	96,167	96.333	96,625	96,875

FIGURE 5.4-1a
6 IN. TNK TST8G16S STRAT TEMPERATURE PROFILE

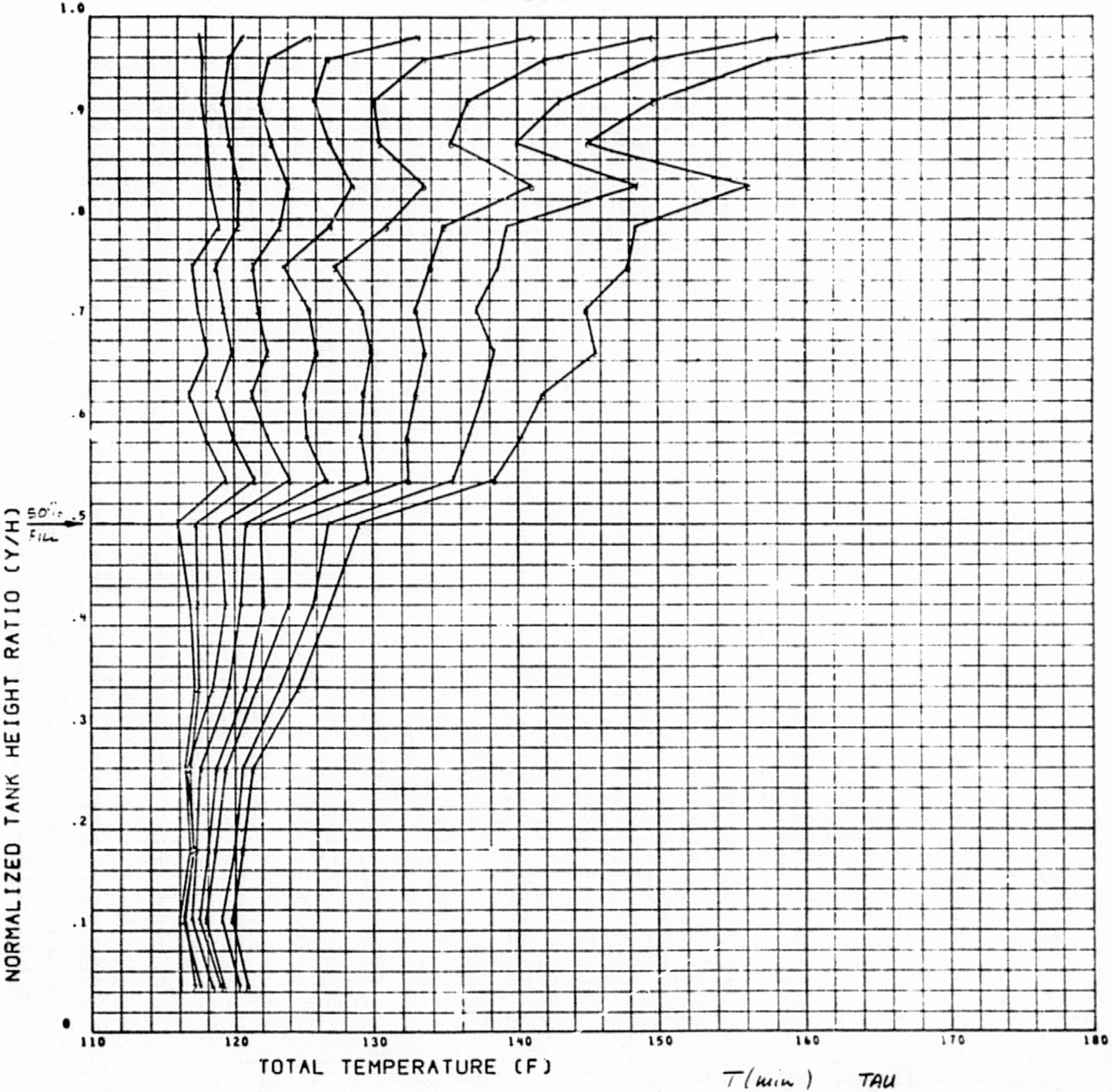


q''_H = 700 BTU/HR FT LIQ +ULLAGE HT'G

	TIME (MINS)	τ (TAU)
1	0.0	0.0
2	.333	.143
3	.667	.286
4	1.333	.571
5	1.667	.714
6	2.000	.857
7	2.333	1.000

FIGURE 5.4-1b

6 IN. TNK TEST 8GΣ 1 OS-STRAT TEMPERATURE PROFILE



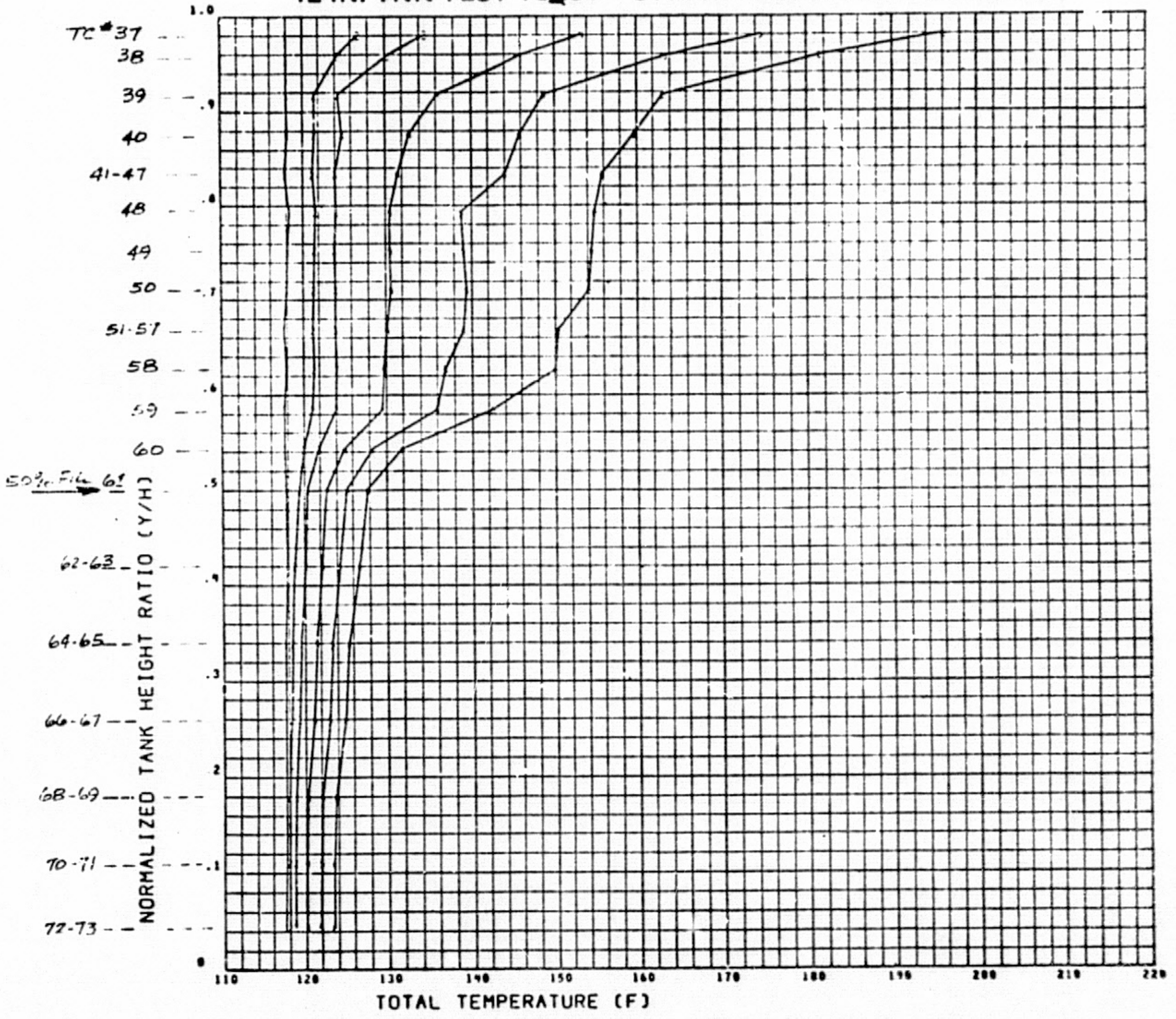
$q''_H = 700$ BTU/hr ft²

LIQ + ULLAGE HT'G

	T(min)	TAU
1	0.	0.
2	.333	.143
3	.666	.285
4	1.	.429
5	1.333	.571
6	1.666	.714
7	2.00	.857
8	2.333	1.0

Figure 5.4-1c

12 IN. TNK TEST 1GΣ34 – STRAT TEMPERATURE PROFILE

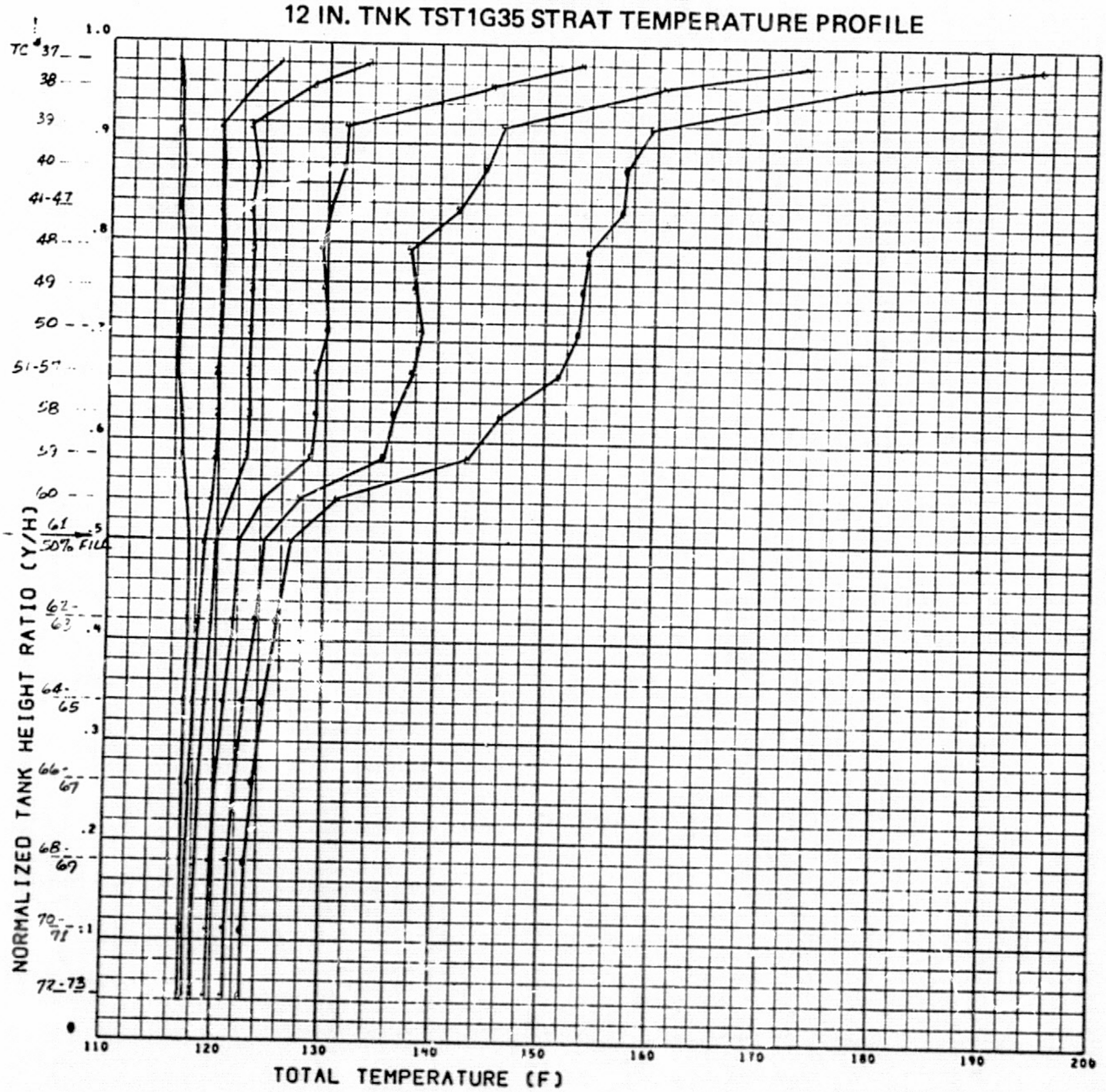


$\frac{q''}{D_H}$ = 350 BTU/hr ft^2

LIQ+ULLAGE HT'G

	Time (min.)	TAU
1	0.	0.
2	2.	.222
3	3.	.333
4	5.	.556
5	7.	.778
6	9.	1.0

FIGURE 5.4-1d
12 IN. TNK TST1G35 STRAT TEMPERATURE PROFILE



$\dot{q}''_{u}$ = 350 BTU/hr ft² LIQ + ULLAGE HT'G

	Time (mins)	τ (TAU)
1	0.	0.
2	2.	.222
3	3.	.333
4	5.	.556
5	7.	.778
6	9.	1.0

FIGURE 5.4-2a
6 IN. TNK TST8G16S STRAT DEL – TEMP PROFILE

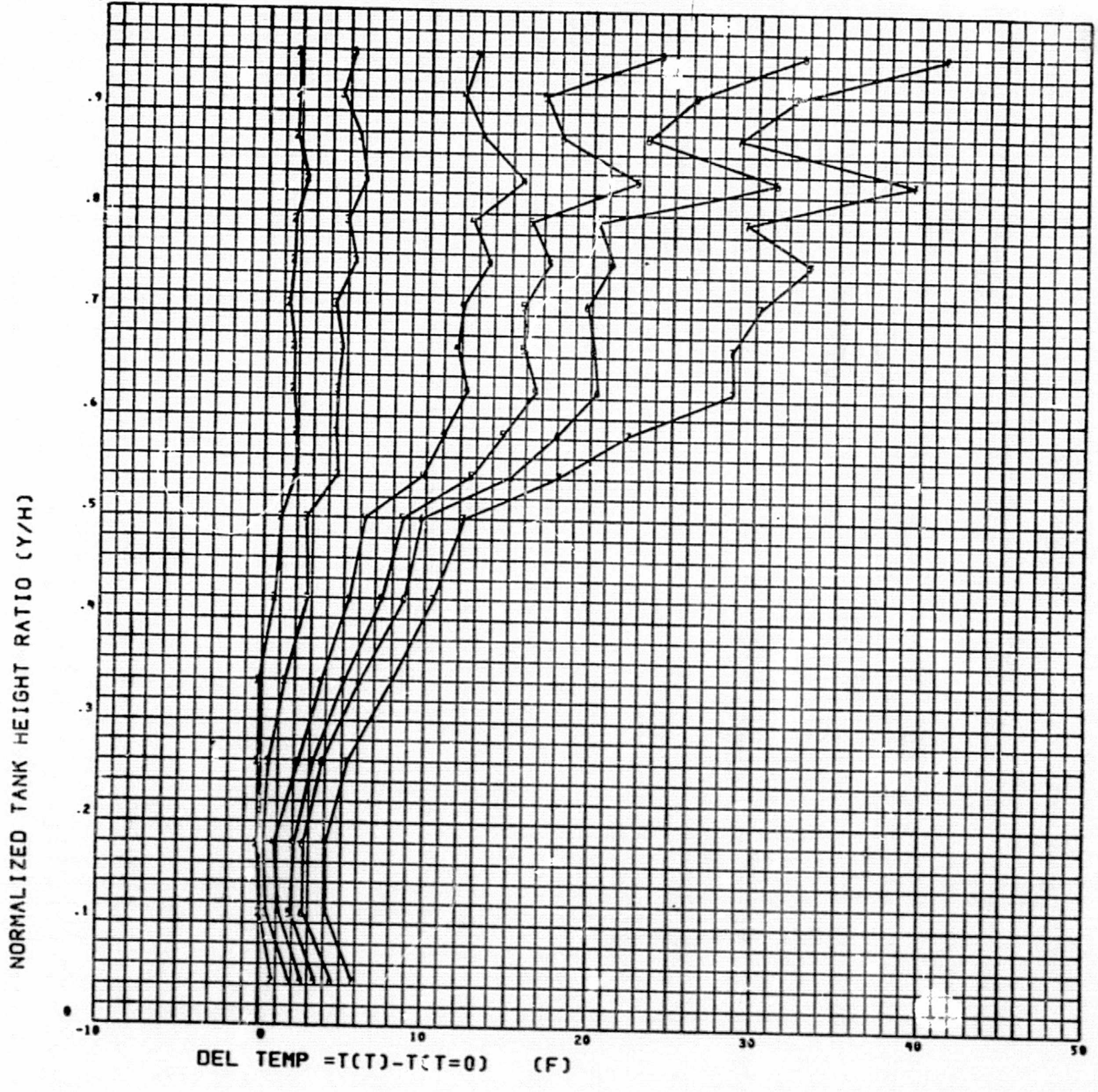


FIGURE 5.4-2b

6 IN. TNK TEST 8GΣ10S – STRAT DEL – TEMP PROFILE

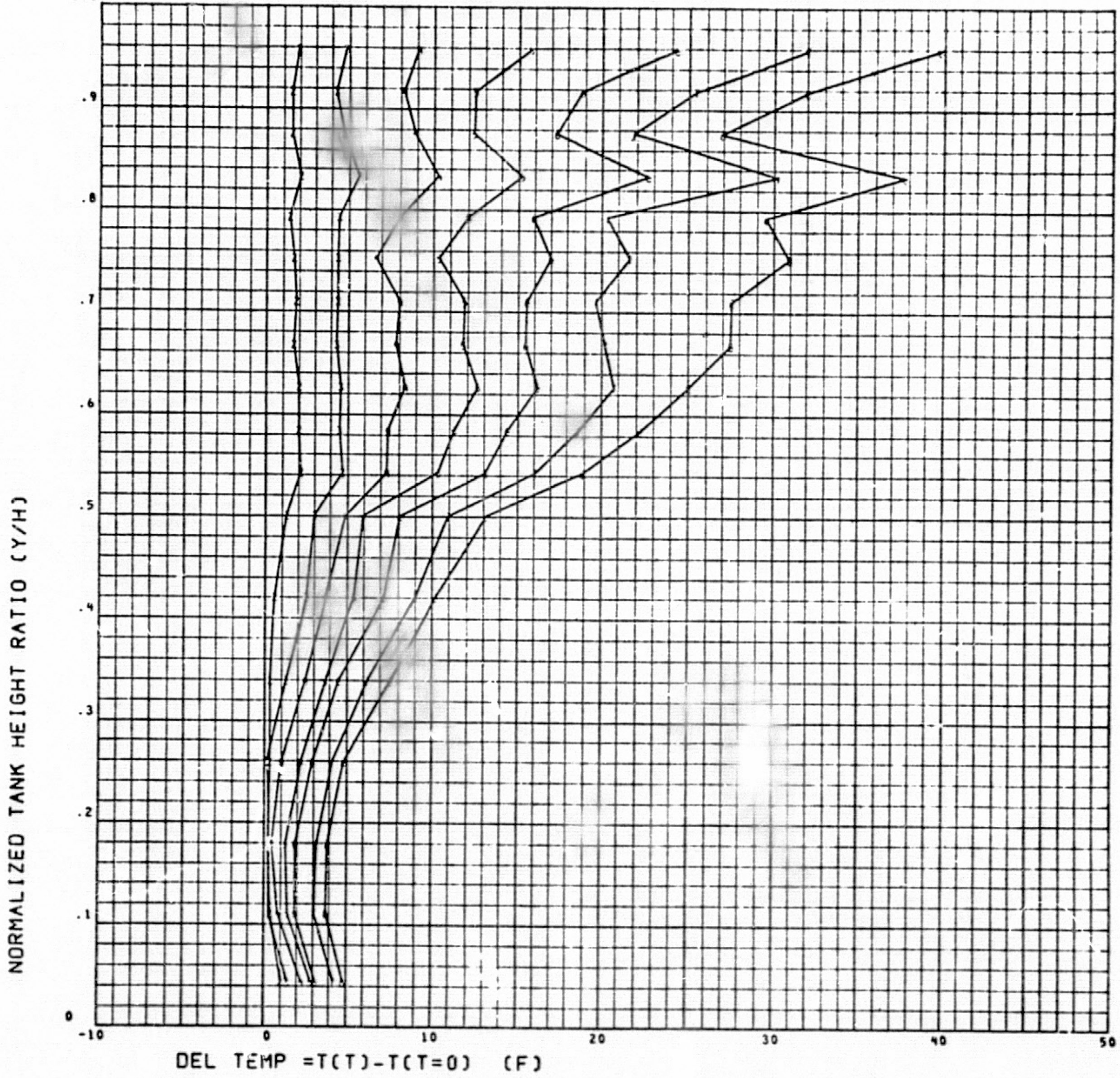


FIGURE 5.4-2c
12 IN. TNK TEST 1GΣ34 – STRAT DEL – TEMP PROFILE

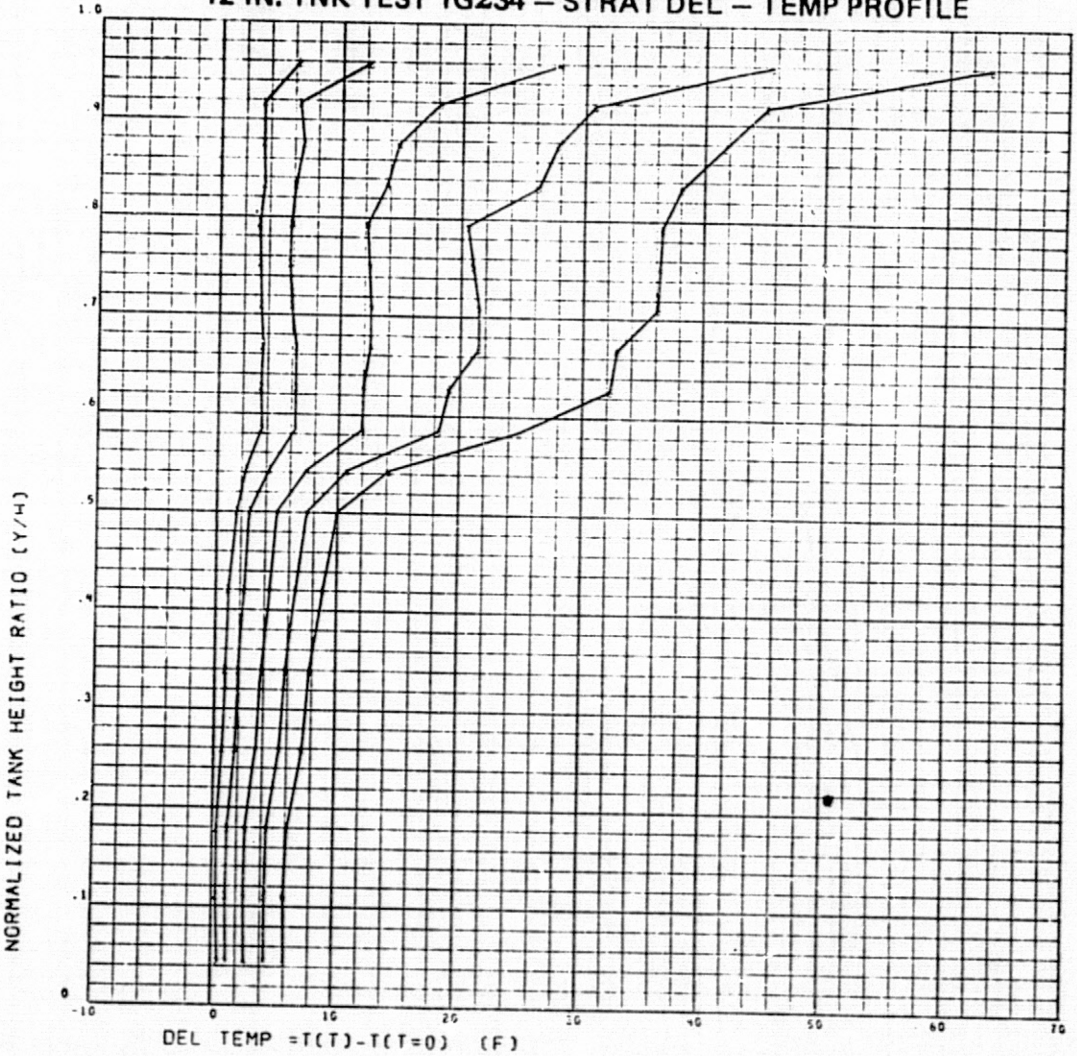


FIGURE 5.4-2d

12 IN. TNK TST1G35 STRAT DEL – TEMP PROFILE

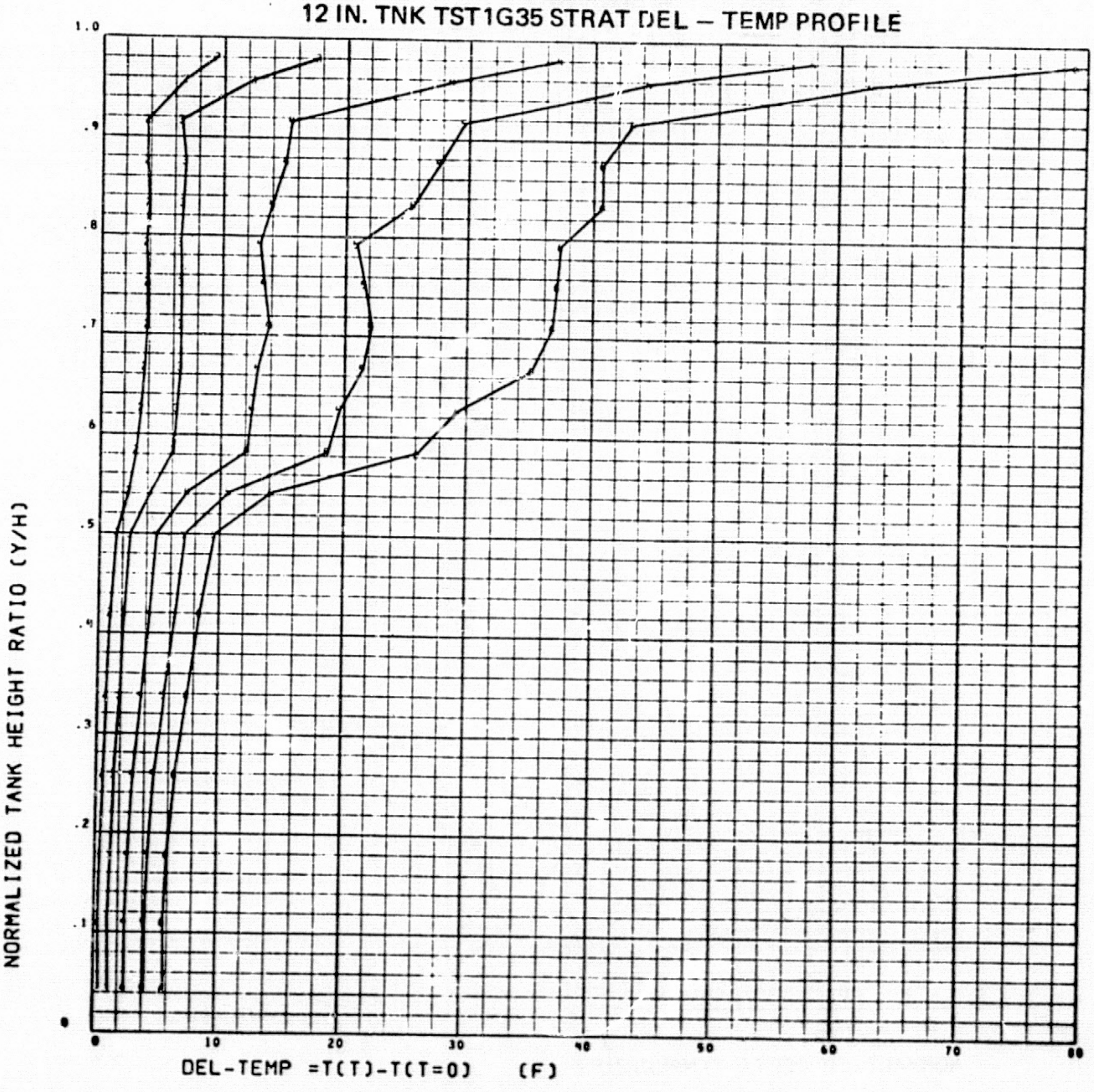


FIGURE 5.4-3a

6 IN. TNK TST8G16S STRAT DTNORM PROFILE

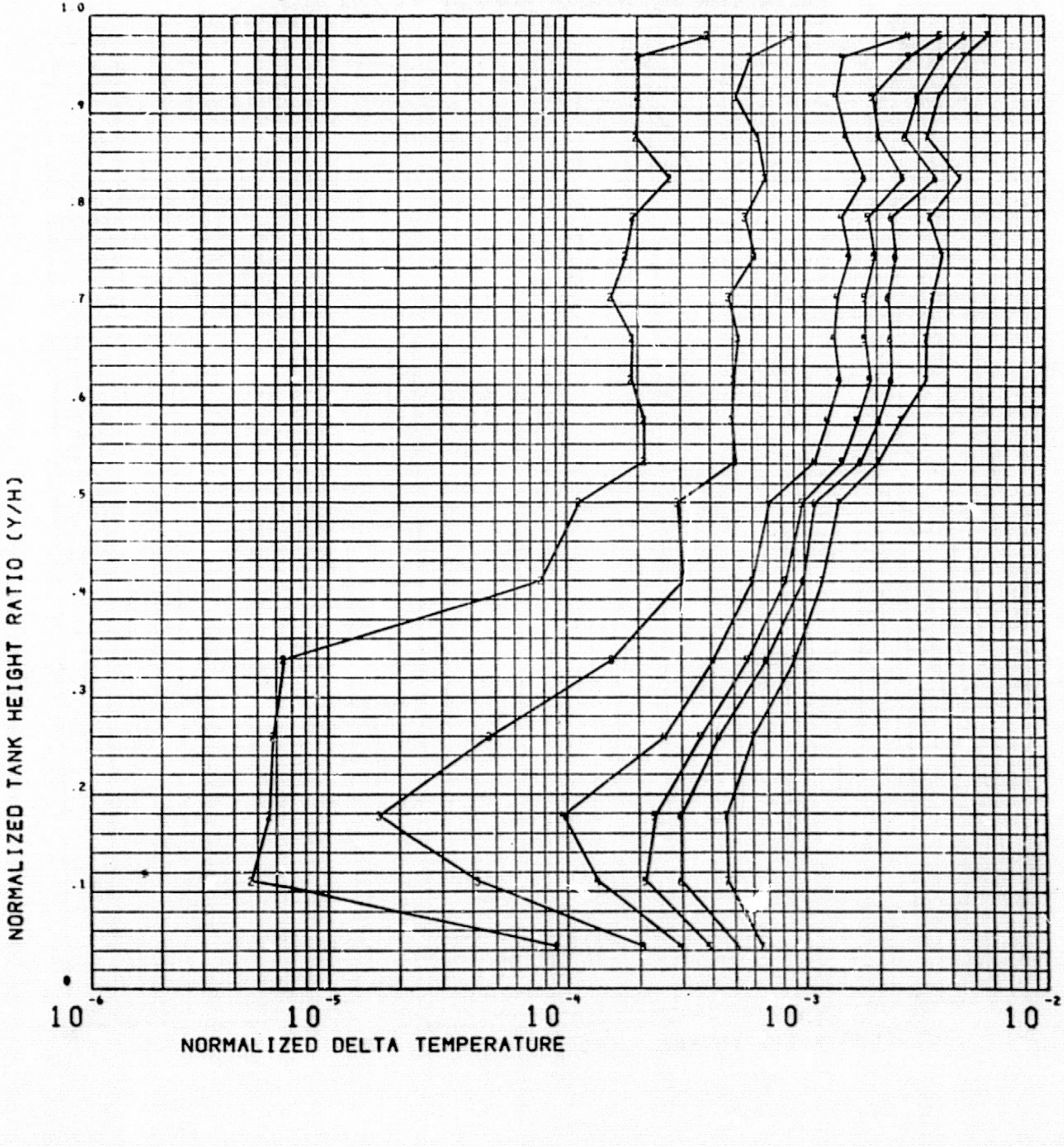


FIGURE 5.4-3b
6 IN. TNK TEST 8GΣ10S – STRAT DTNORM PROFILE

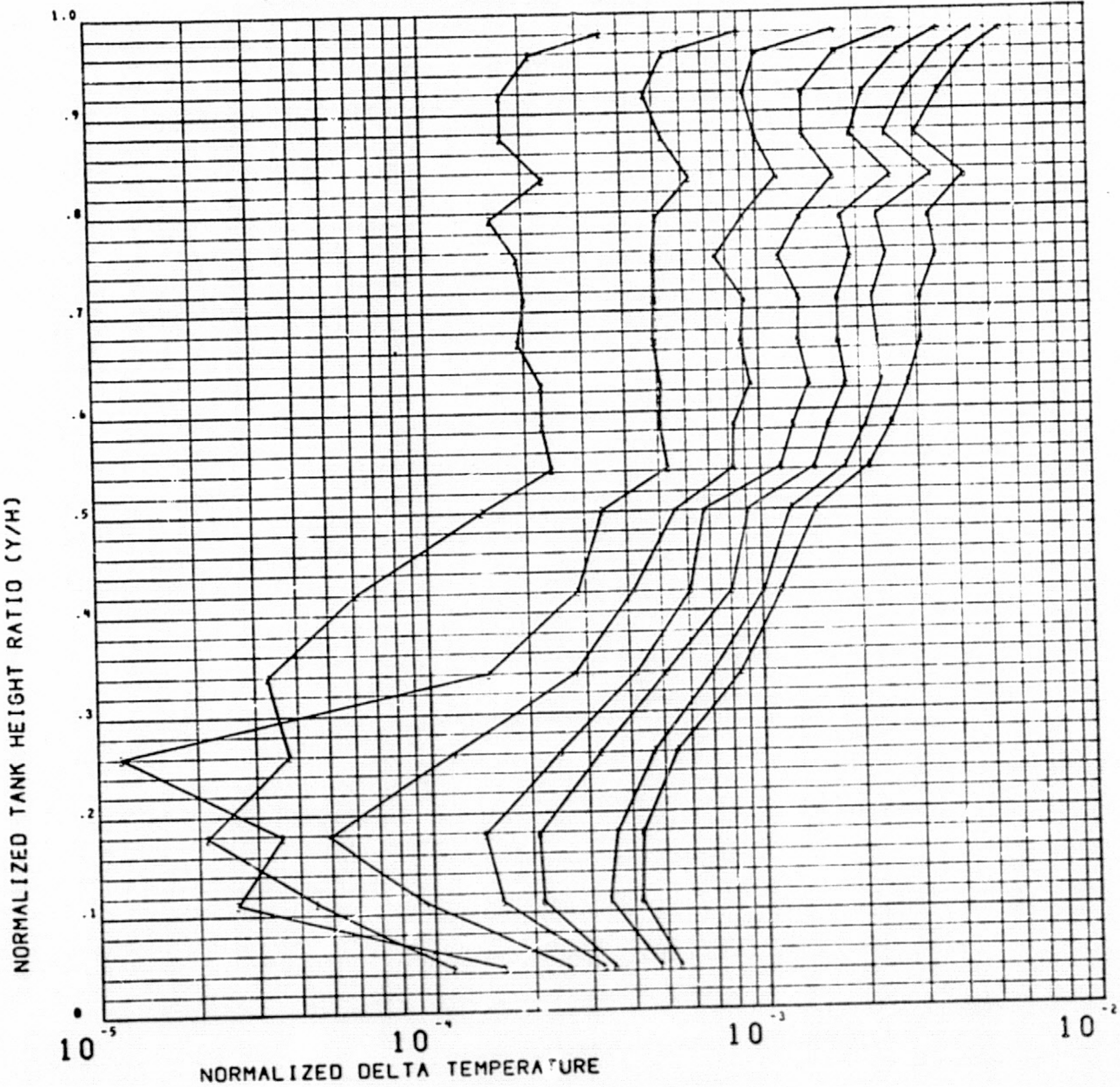


FIGURE 5.4-3c

12 IN. TNK TEST 1GΣ34 – STRAT DTNORM PROFILE

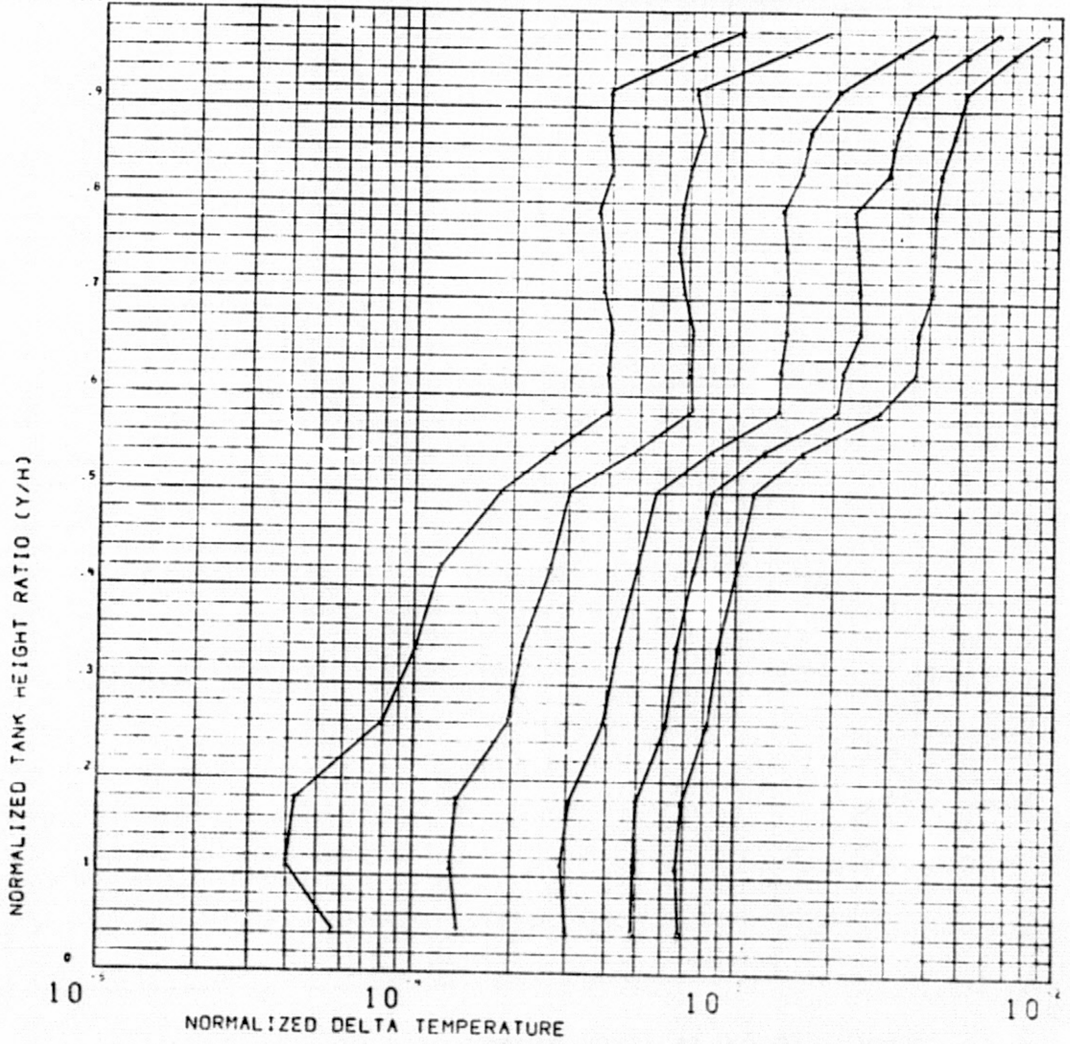


FIGURE 5.4-3d
12 IN. TNK TST1G35 STRAT DTNORM PROFILE

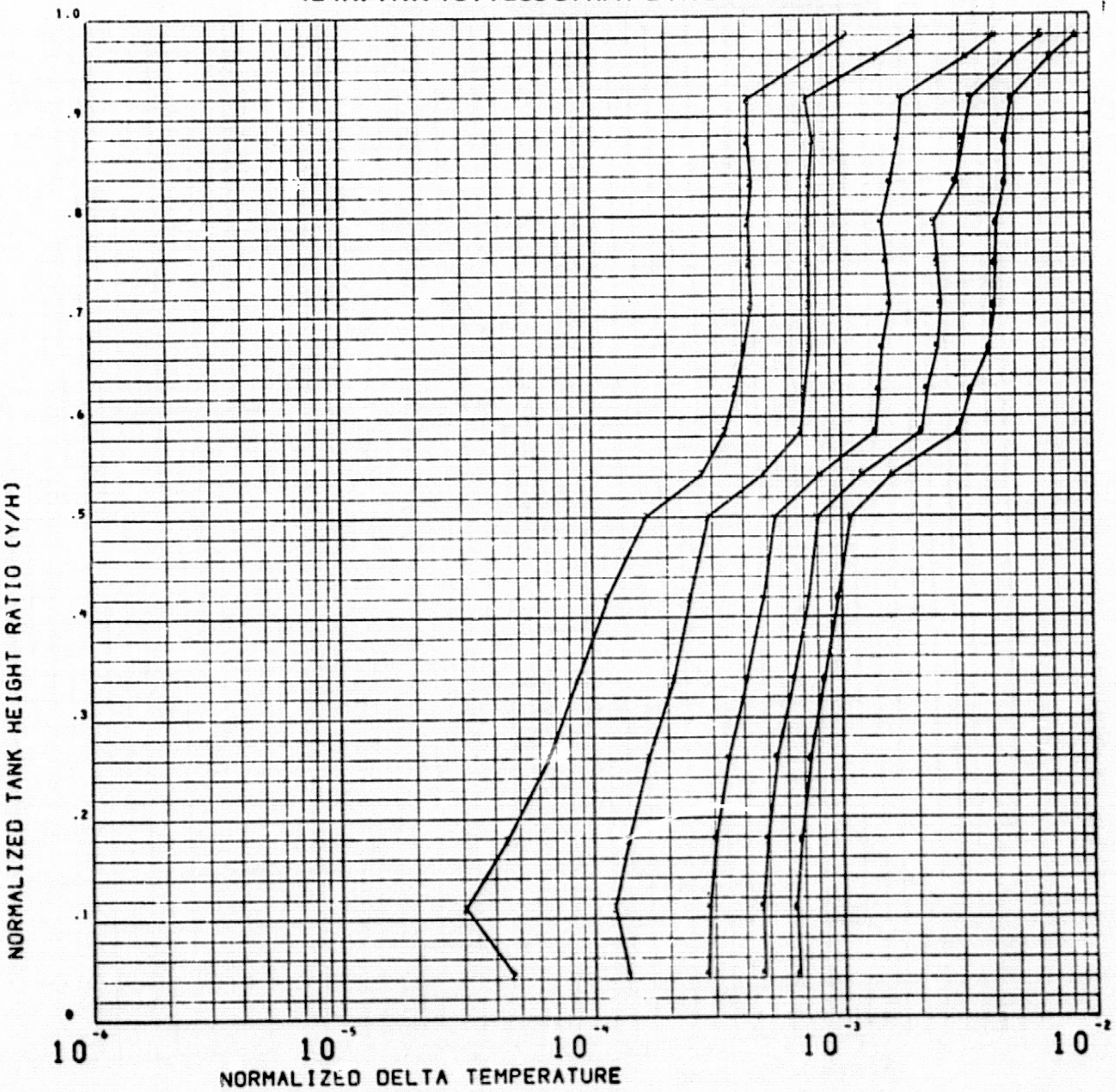


FIGURE 5.4-4a
6 IN. TNK TST8G16S BULK ULGE /LIQ TEMP HISTORIES

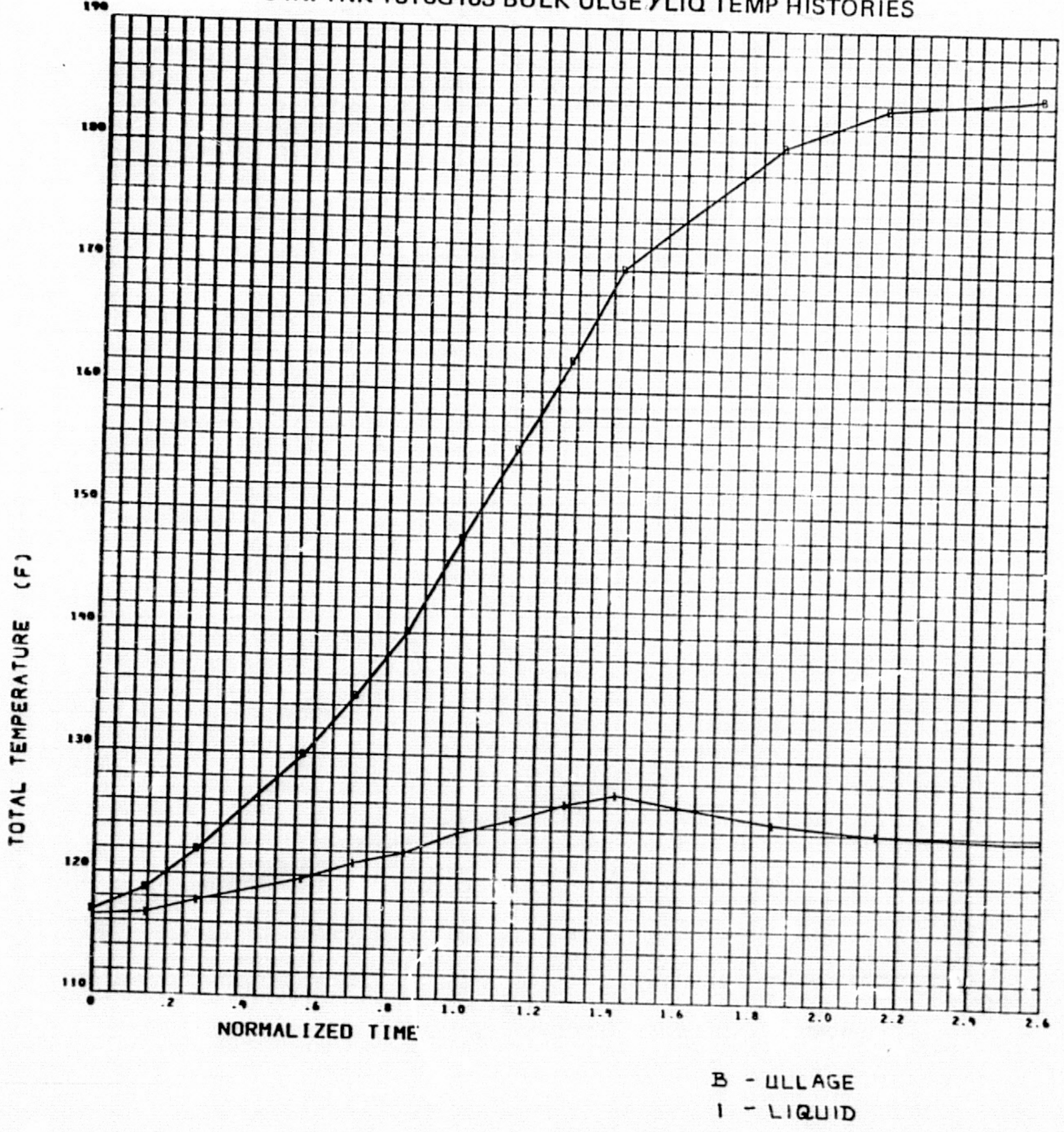


FIGURE 5.4-4b

6 IN. TNK TST 8GΣ10S – BULK ULGEY LIQ TEMP HISTORIES

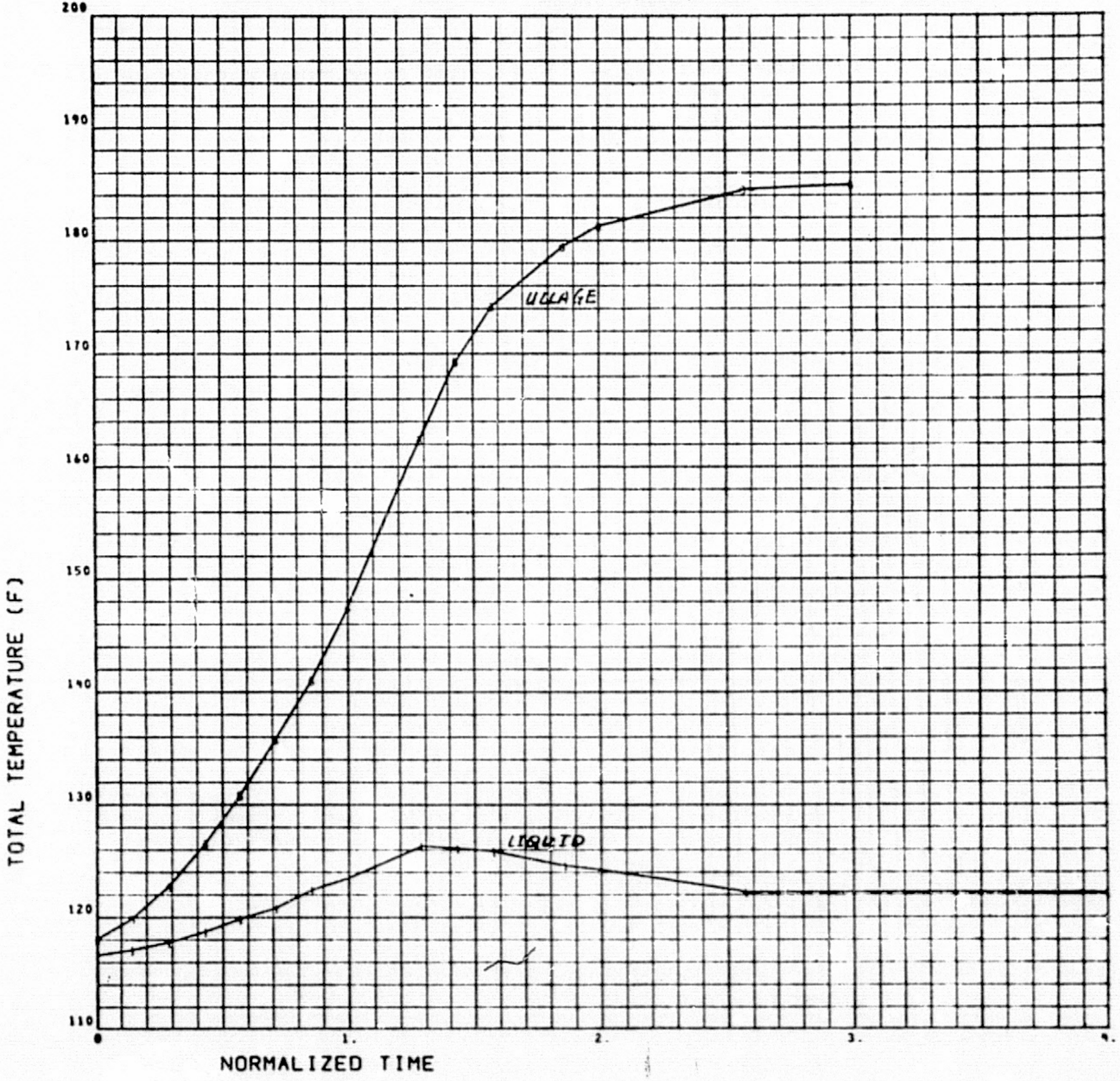


FIGURE 5.4-4c
12 IN. TNK TEST 1GΣ34 – BULK ULGE γ LIQ TEMP HISTORIES

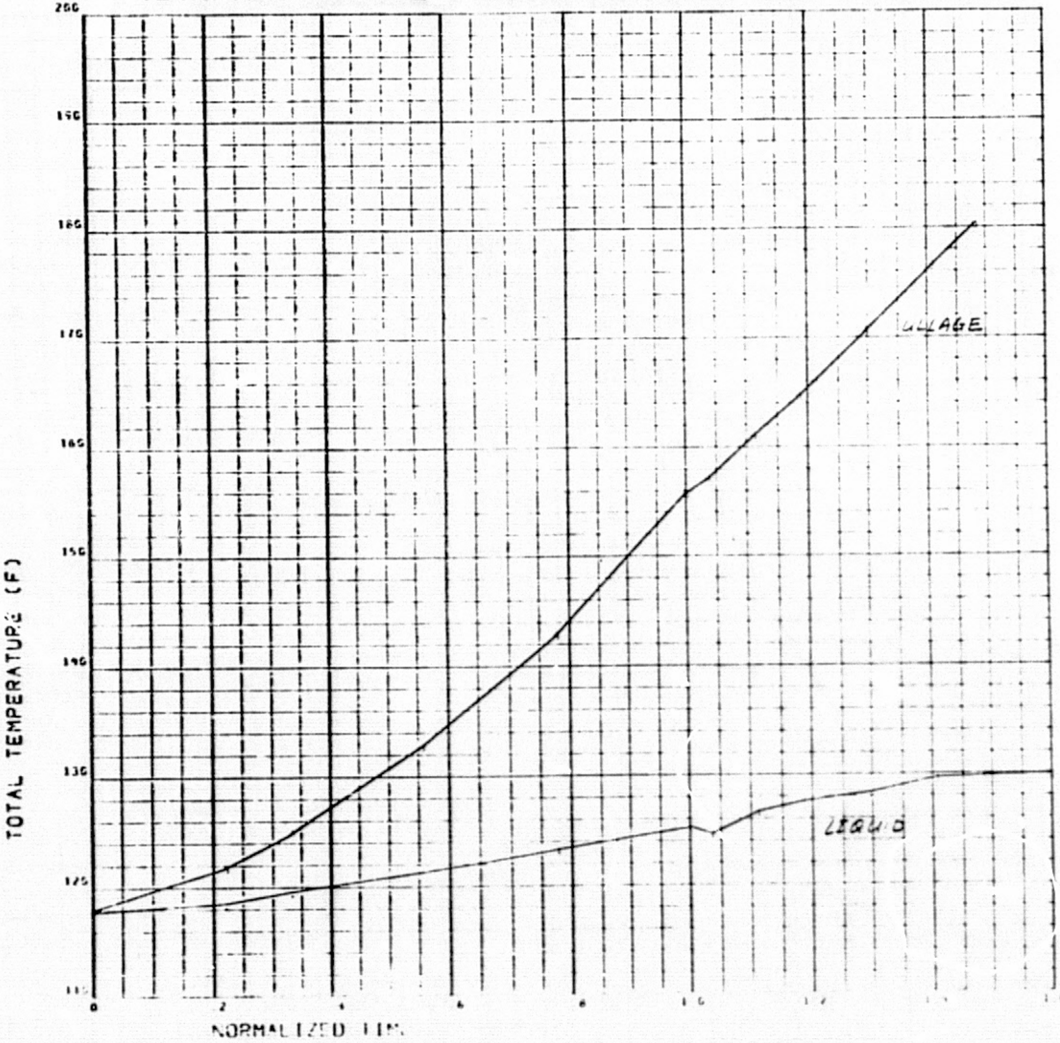
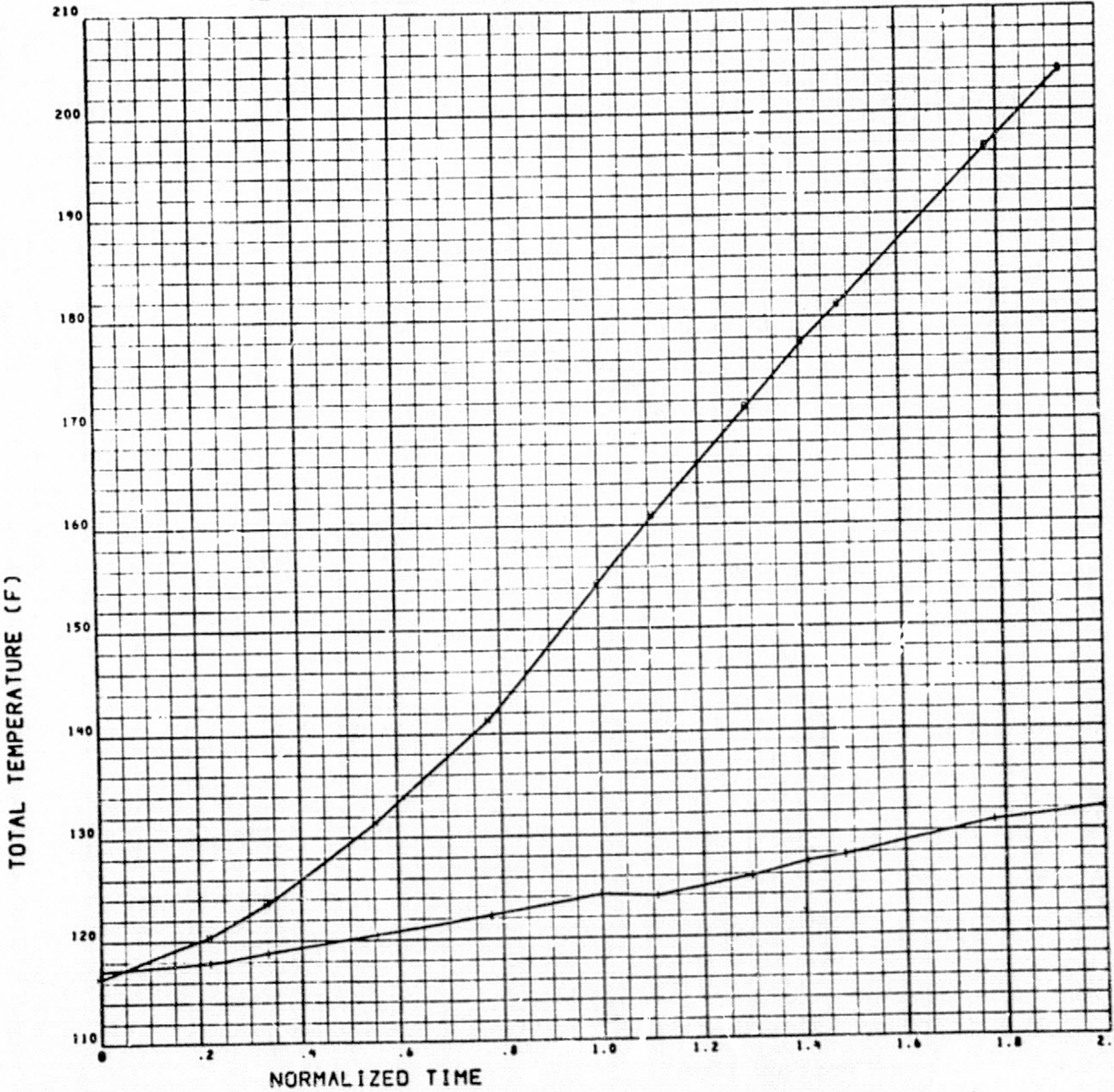


FIGURE 5.4-4d

12 IN. TNK TST1G35 BULK ULGE Y LIQ TEMP HISTORIES



B - ULLAGE
I - LIQUID

FIGURE 5.4-5a
6 IN. TNK TST8G16S TANK PRESSURE HISTORY

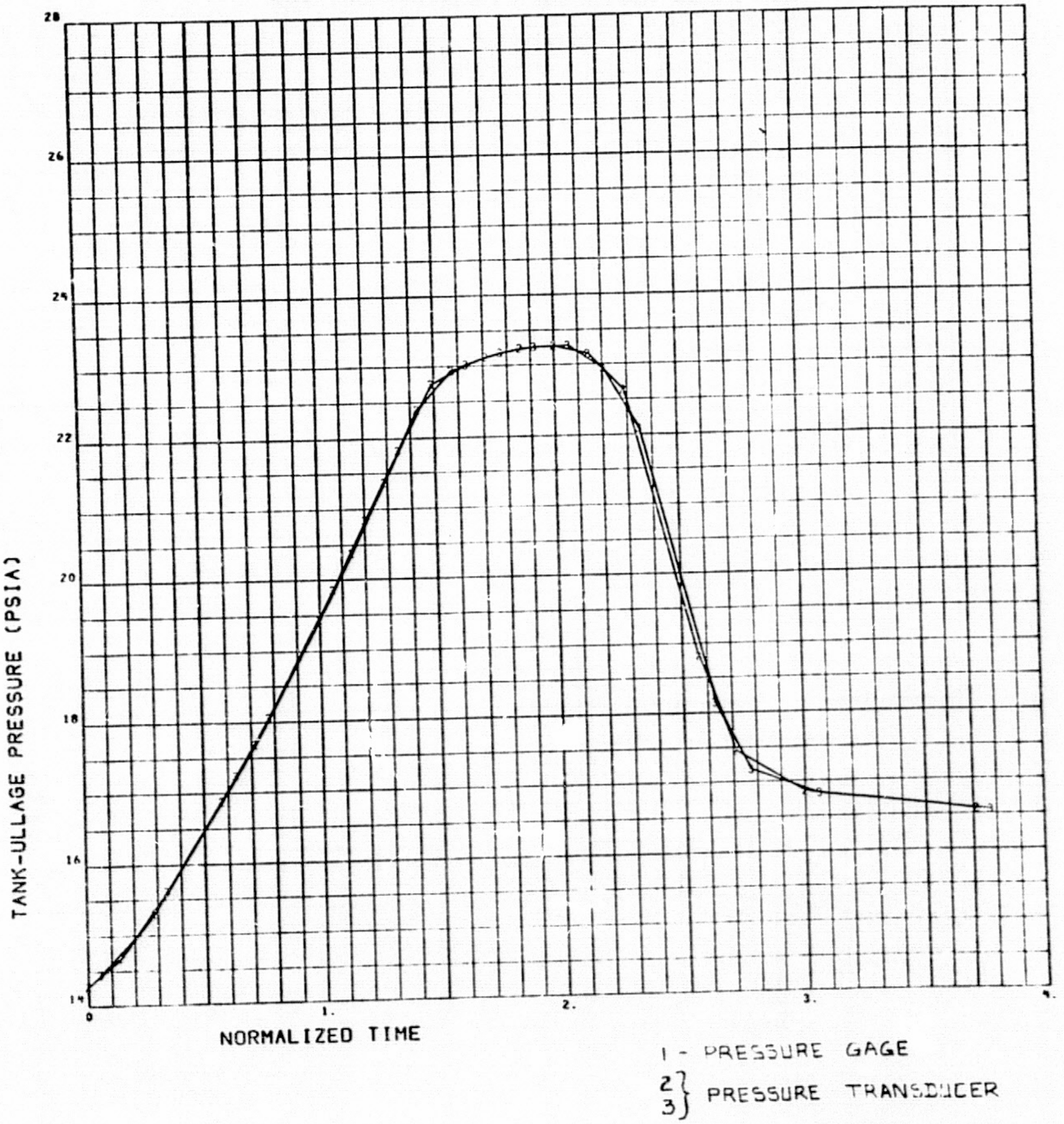
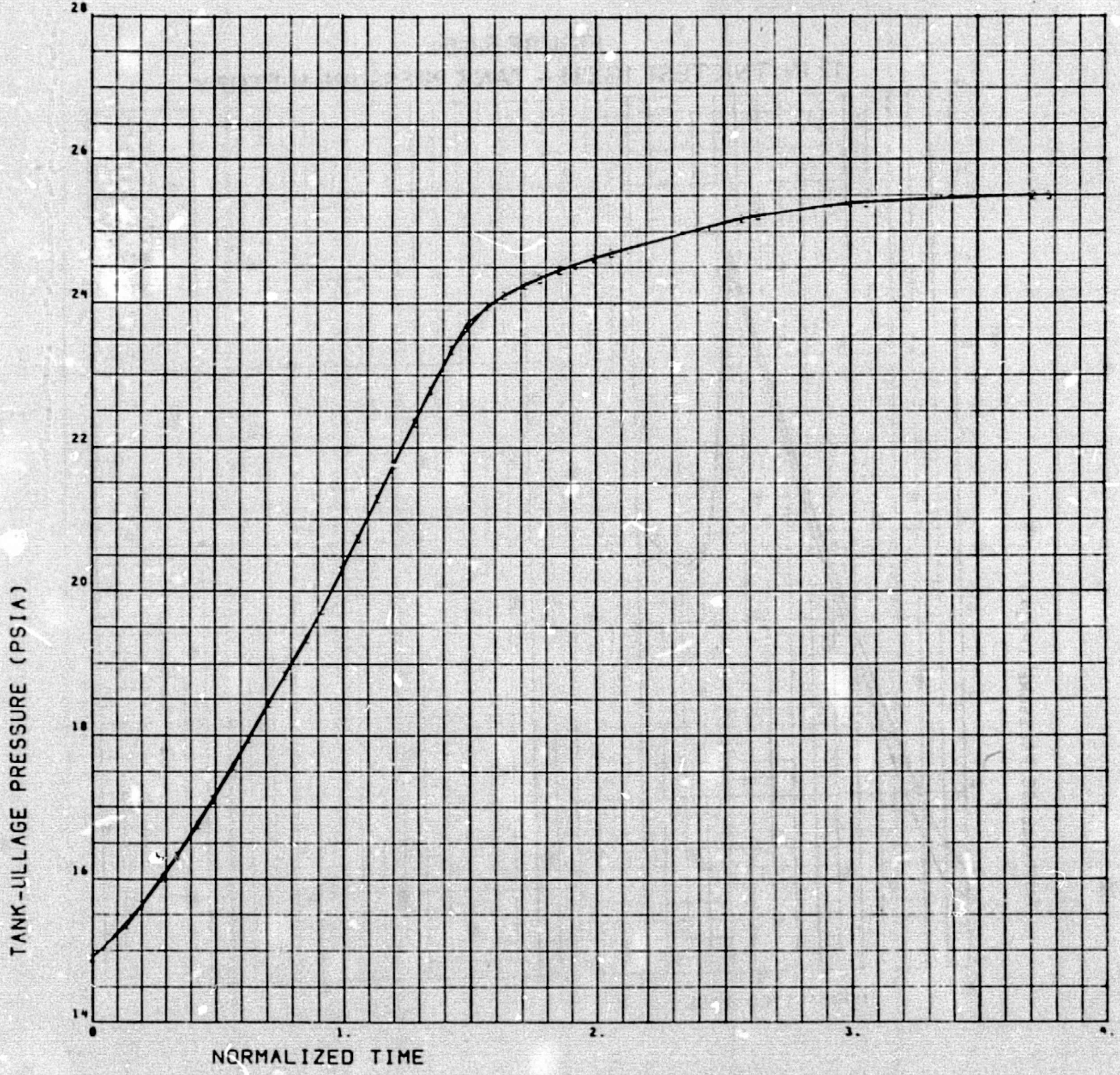


FIGURE 5.4-5b
6 IN. TNK TEST 8GΣ10S – TANK PRESSURE HISTORY

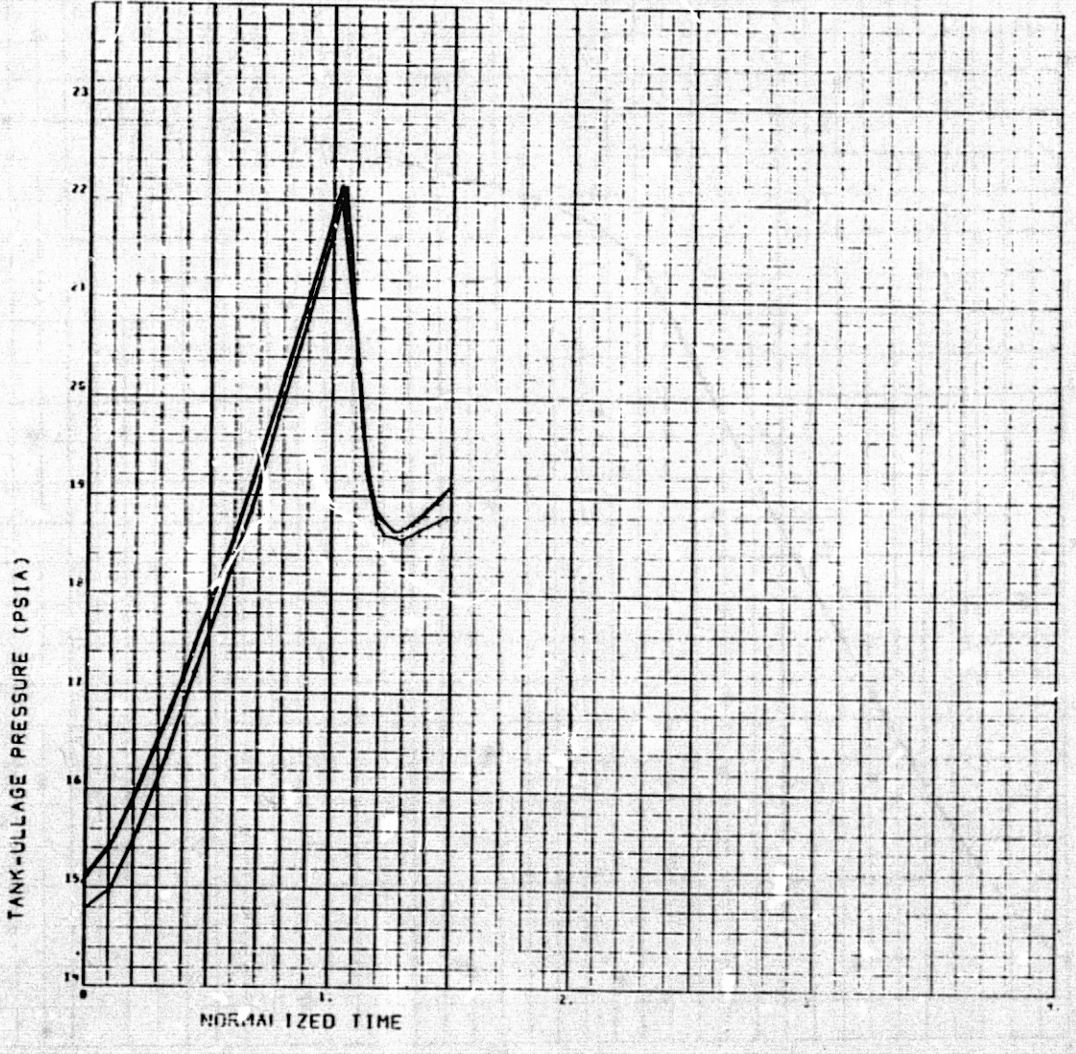


$\left.\begin{matrix}2\\3\end{matrix}\right\}$ Pressure - Transducer

C-3

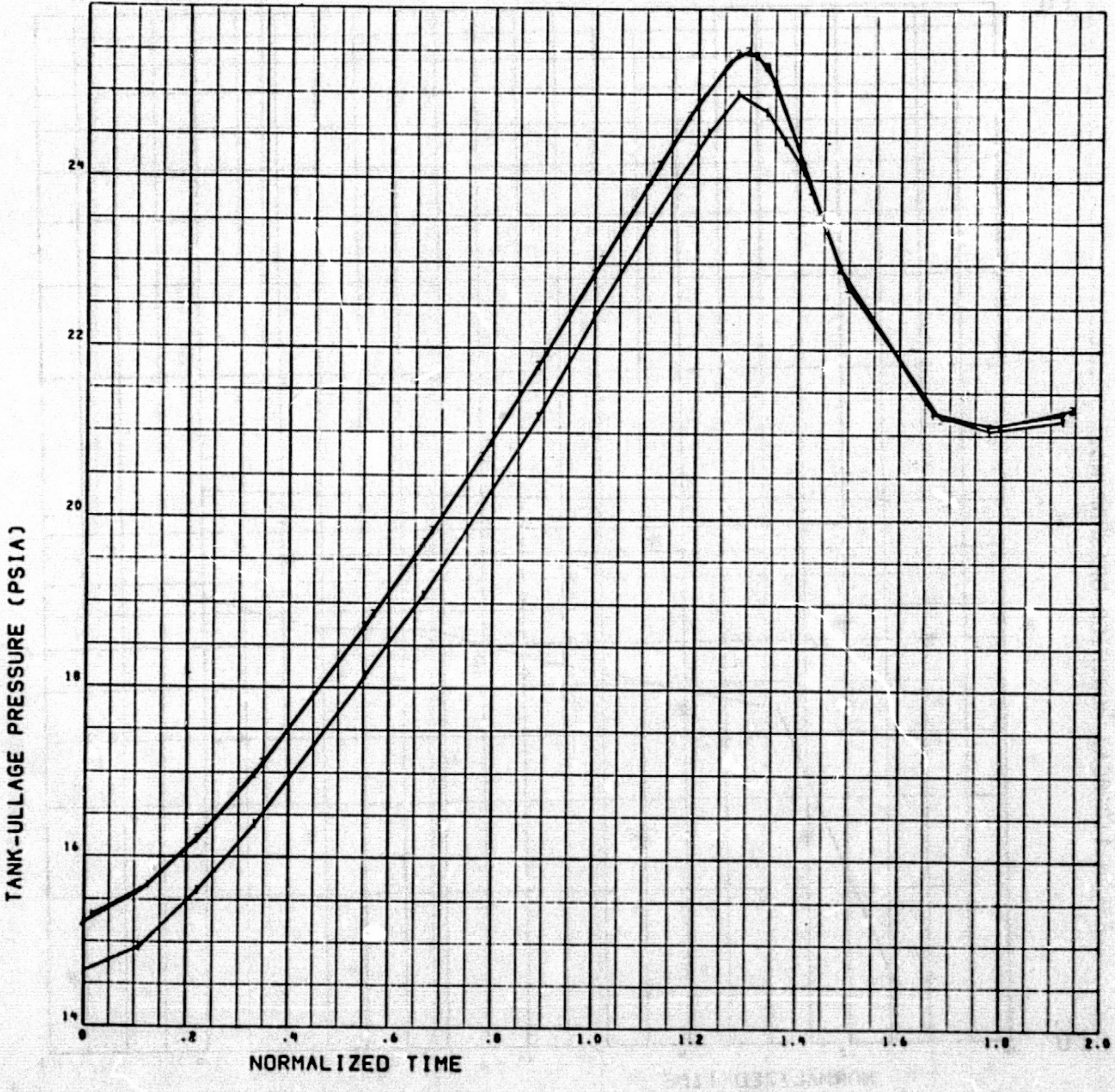
FIGURE 5.4-5c

12 IN. TNK TEST 1GΣ34 – TANK PRESSURE HISTORY



1 - GAGE
2 }
3 } - TRANSDUCER

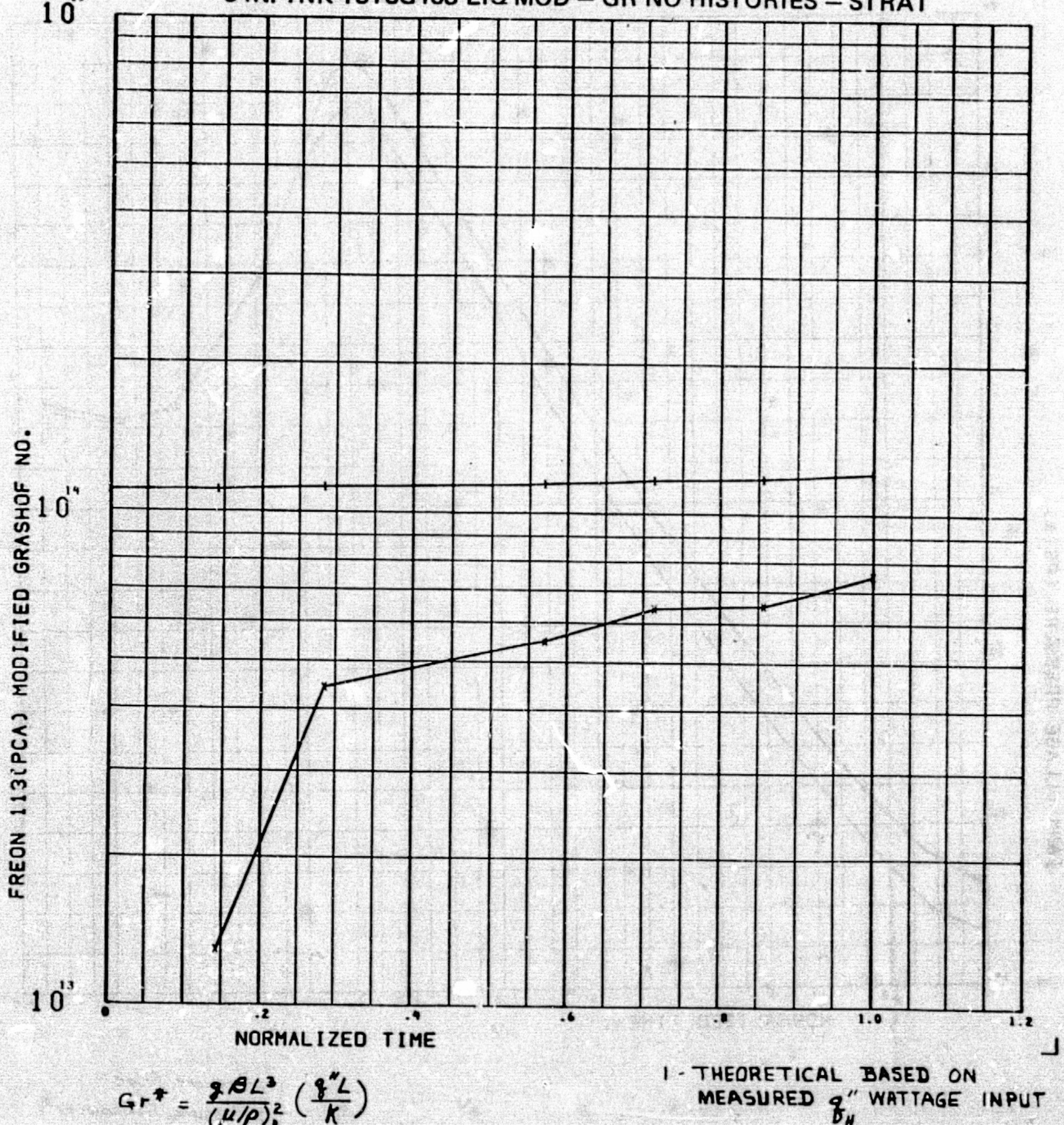
FIGURE 5.4-5d
12 IN. TNK TST1G35 TANK PRESSURE HISTORY



1 - Pressure Gage
2
3 > Pressure Transducer

FIGURE 5.4-6a

6 IN. TNK TST8G16S LIQ MOD – GR NO HISTORIES – STRAT



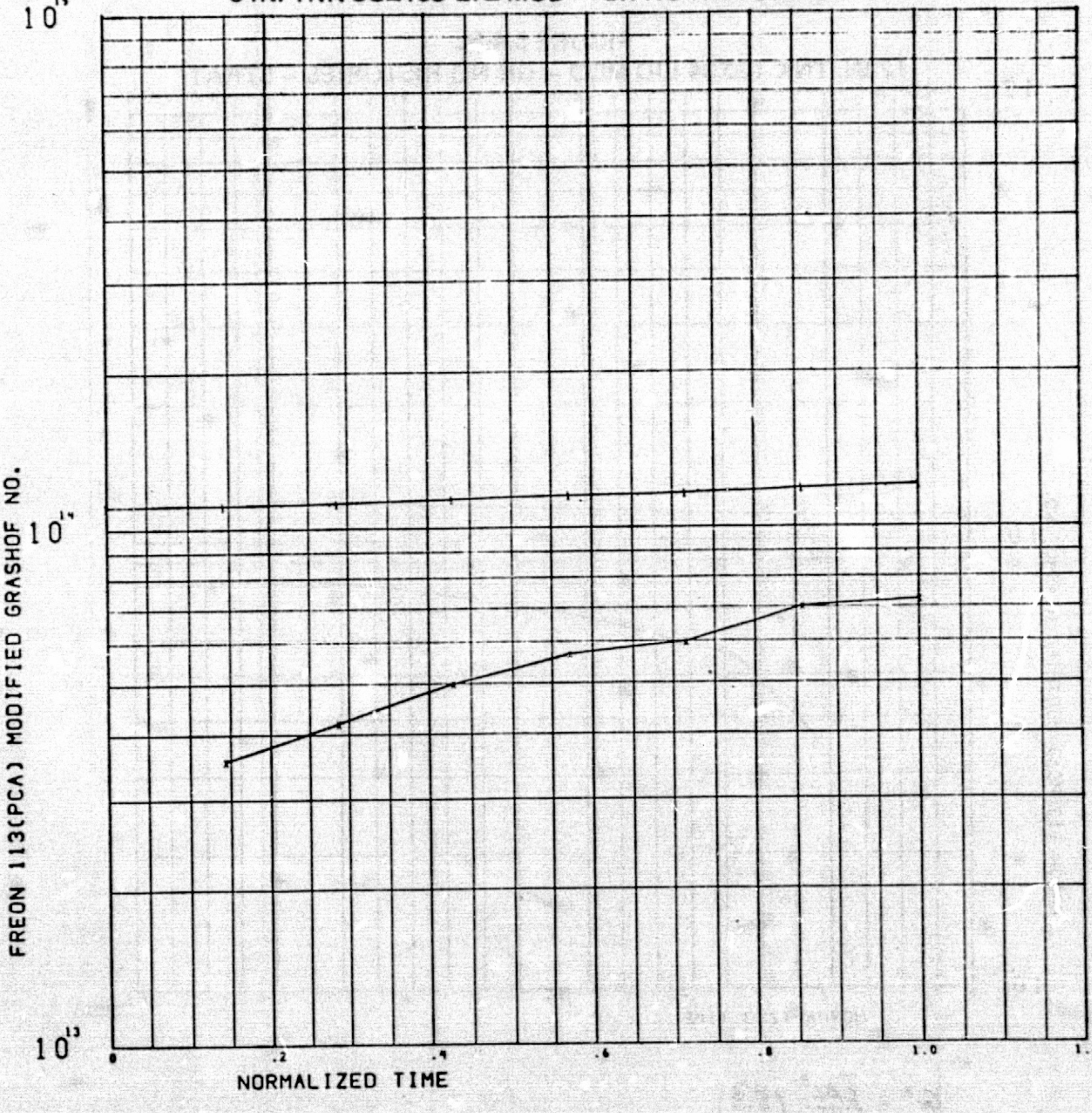
$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2_\ell}\left(\frac{q''L}{K}\right)$$

L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL BASED ON MEASURED q''_H WATTAGE INPUT

X - EXPERIMENTAL BASED ON MEASURED q''_ℓ FLUID

FIGURE 5.4-6b
6 IN. TNK 8GΣ10S LIQ MOD – GR NO HISTORIES – STRAT



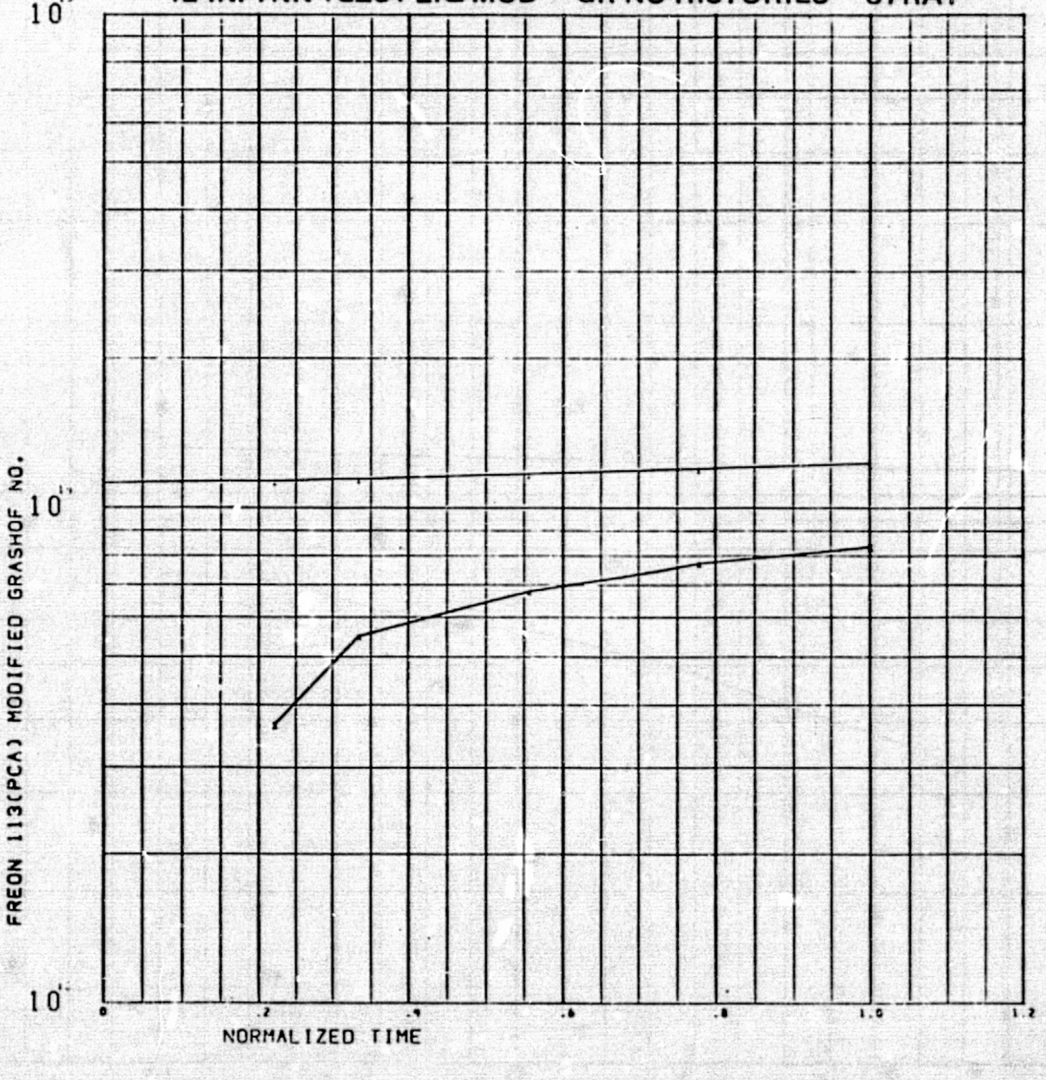
$$Gr^{*} = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q''L}{k}\right)$$

1 - Theoretical based on measured q''_H wattage input

x - Experimental based on measured q''_{Fluid}.

L = Fluid depth

FIGURE 5.4-6c
12 IN. TNK 1GΣ34 LIQ MOD – GR NO HISTORIES – STRAT



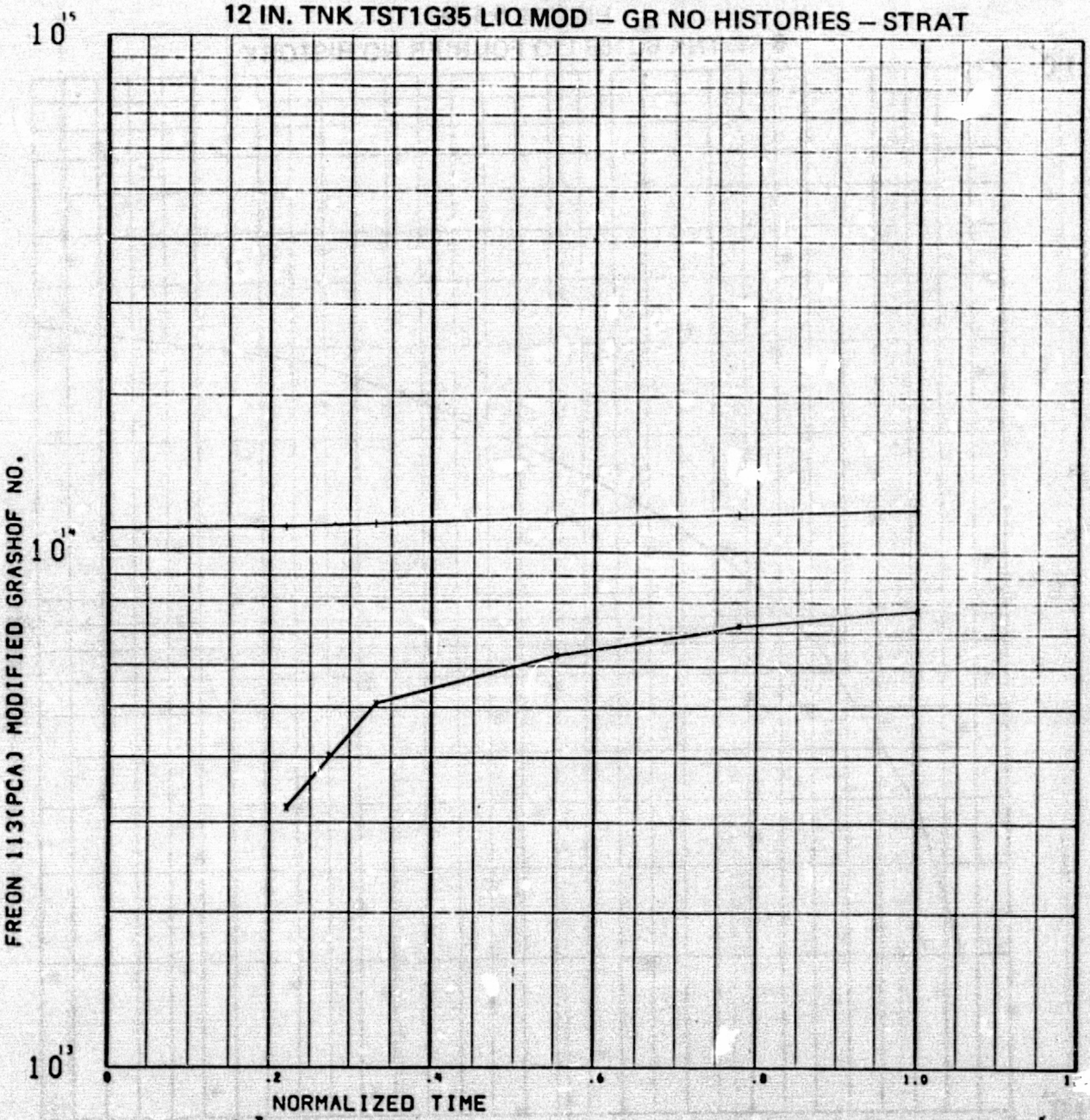
$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q'' L}{k}\right)$$

L - Fluid depth

1 – Theoretical based on measured q''_{input} wattage

x – Experimental based on measured q''_{fluid}.

FIGURE 5.4-6d
12 IN. TNK TST1G35 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

L = Fluid (Freon PCA(113)) depth

1 - Theoretical based on measured $q''_{\text{wattage input}}$

X - Experimental based on measured q''_{fluid}

FIGURE 5.4-7a

6 IN. TNK 8G16S LIQ FOURIER NO HISTORY

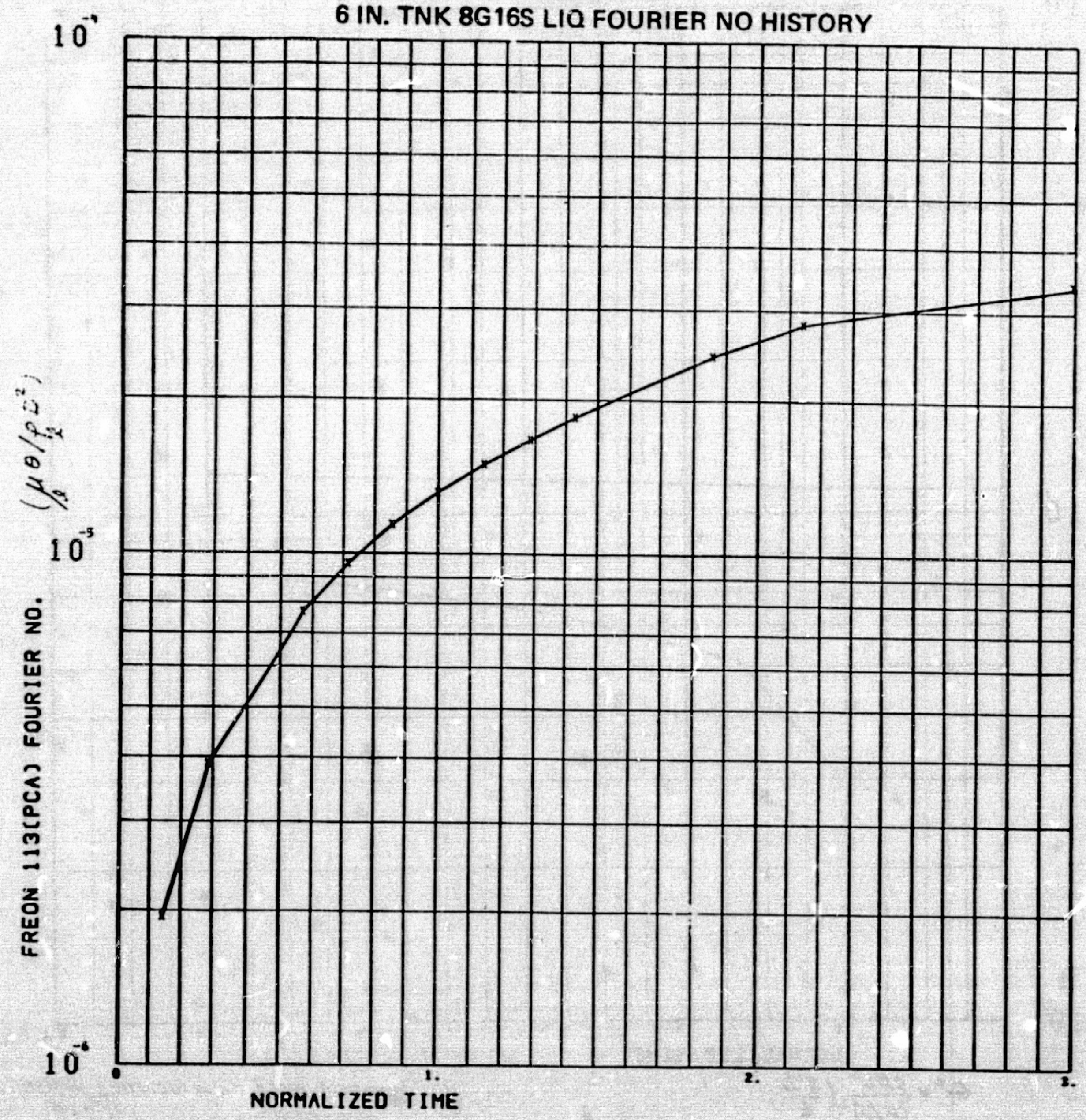


FIGURE 5.4-7b
6 IN. TNK 8GΣ10S LIQ FOURIER NO HISTORY

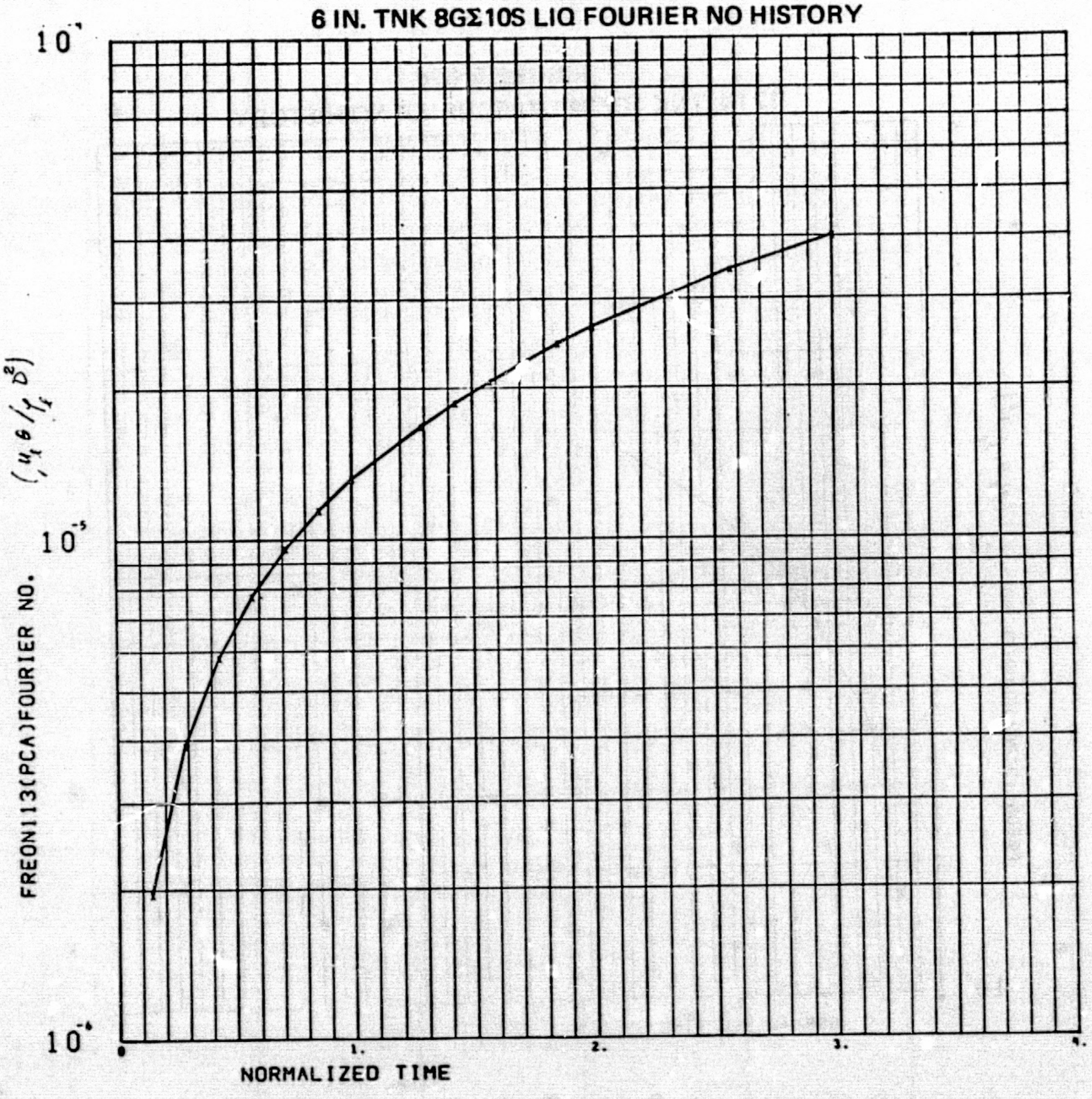


FIGURE 5.4-7c

12 IN. TNK 1GΣ34 LIQ FOURIER NO HISTORY

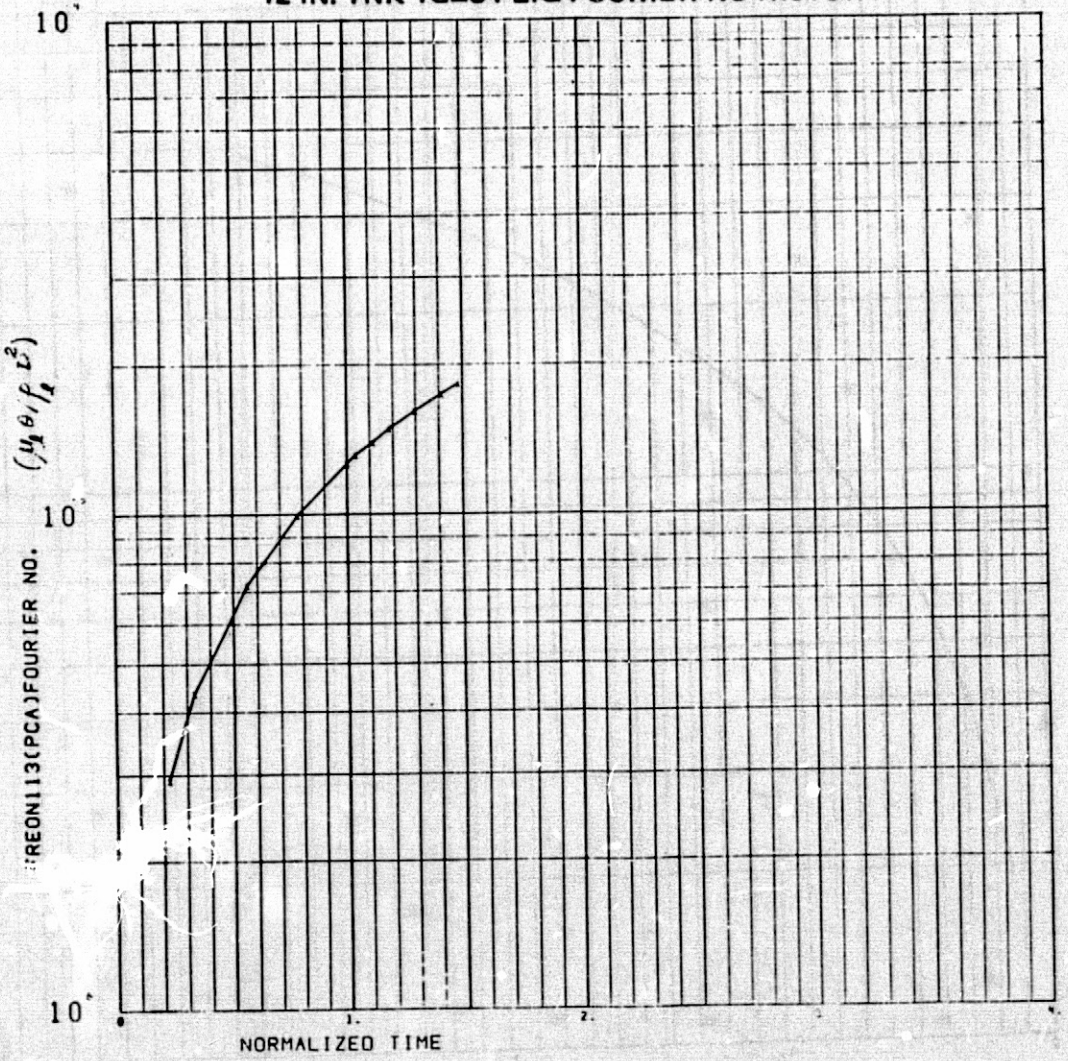
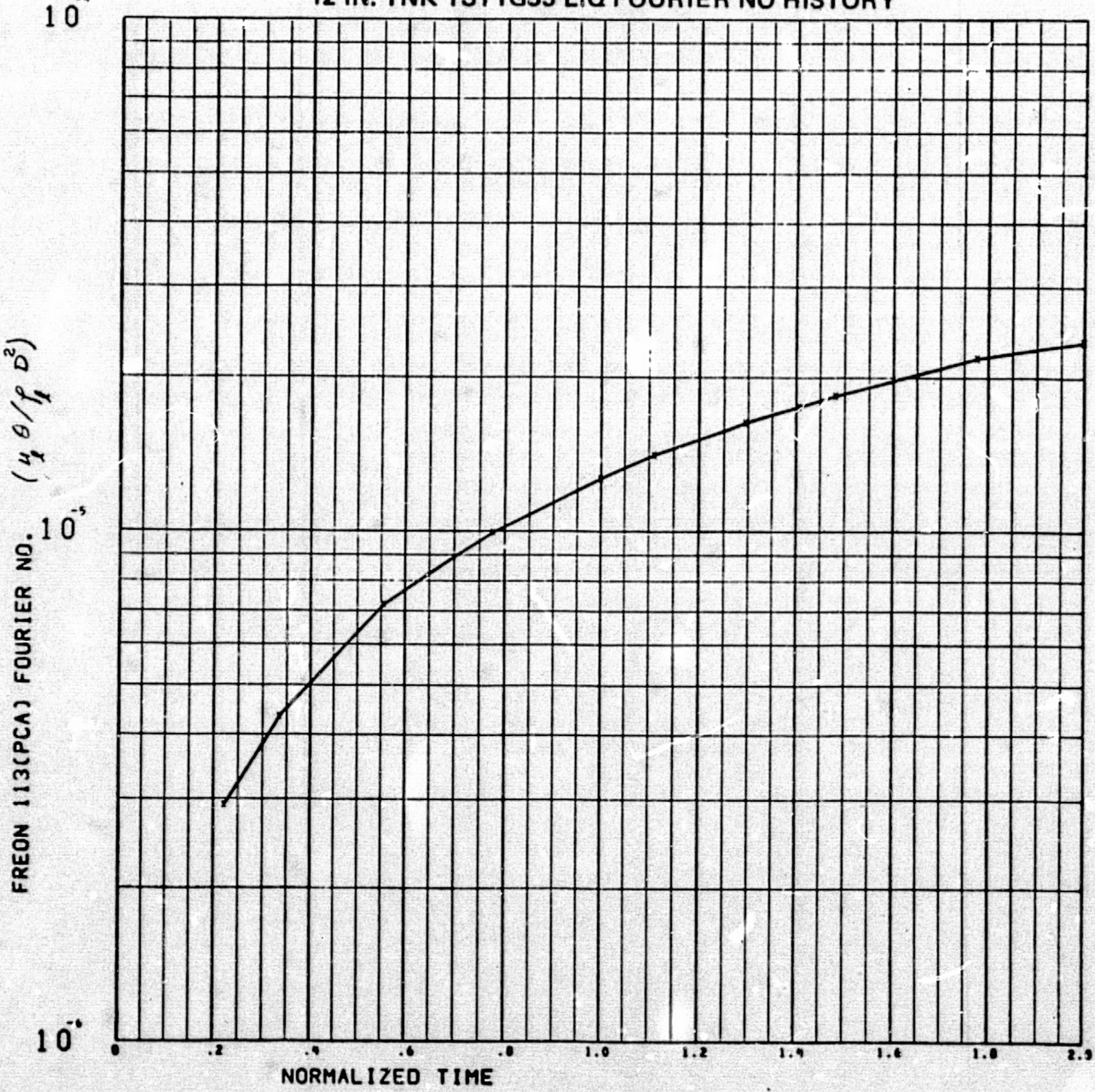


FIGURE 5.4-7d
12 IN. TNK TST1G35 LIQ FOURIER NO HISTORY



Section 5. 5

SCALING SET

6-in. -Dia Tank Tests	12-in. -Dia Tank Tests
8G	1G
Test #1 Test #5 Test #8S	Test #20 Test #22

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Table 5.5-1a. 6 IN. DIA. TANK TEST 8G#1 (Page 1 of 3)

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


  DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708        FLNGE AREA FT2=    .0365
 DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=    .00164      FLNGE VOL FT3=      .00076
 DME MASS LBM=    .65596       MASS 1/2 CYL LBM=    .81996       FLANGE MASS=    .38058

  LIQ VOL FT3=    .22907       ULLAGE VOL FT3=    .03272
 ------------------------------------------------------------------------------------------
  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12= 600.8488   H34= 600.8488   H56= 600.8488   H910= 600.8488   H78=   0.0000

 EST.HT FLUX IN LIQ (BTU/HR-FT2)= 600.8488
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
 EST.HT INPUT LIQ(STRAT)BTU=    71.966      (STRAT+DESTRAT)BTU=  111.409
 EST.LIQ TEMP INCRSE(STRAT)=    14.7694F     (STRAT+DESTRAT)=   22.8544F
 ------------------------------------------------------------------------------------------
 EST.HT INPUT ULLAGE(STRAT)BTU=     0.000      (STRAT+DESTRAT)BTU=     0.000
```

Table 5.5-1b. 6 IN. DIA. TANK TEST 8G#5

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


  DOME AREA FT2=    .3927        CYL AREA FT2=  1.5708        FLNGE AREA FT2=    .0365
 DME WALL VOL FT3=    .00131       1/2 CYL WALL VOLFT3=    .00164      FLNGE VOL FT3=      .00076
 DME MASS LBM=    .65596       MASS 1/2 CYL LBM=    .81996       FLANGE MASS=    .38058
 ------------------------------------------------------------------------------------------
  LIQ VOL FT3=    .22907       ULLAGE VOL FT3=    .03272

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES
 ------------------------------------------------------------------------------------------
 H12= 600.8488   H34= 600.8488   H56= 600.8488   H910= 600.8488   H78=   0.0000
 ------------------------------------------------------------------------------------------
 EST.HT FLUX IN LIQ (BTU/HR-FT2)= 600.8488
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
 EST.HT INPUT LIQ(STRAT)BTU=    72.095      (STRAT+DESTRAT)BTU=  216.290
 EST.LIQ TEMP INCRSE(STRAT)=    14.7966F     (STRAT+DESTRAT)=   44.3818F

 EST.HT INPUT ULLAGE(STRAT)BTU=     0.000      (STRAT+DESTRAT)BTU=     0.000
```

Table 5.5-1c. 6 IN. DIA. TANK TEST #8S (Page 2 of 3)

```
            STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    ,3927        CYL AREA FT2=  1,5708        FLNGE AREA FT2=    ,0365
DME WALL VOL FT3=    ,00131       1/2 CYL WALL VOLFT3=    ,00164      FLNGE VOL FT3=    ,00076
DME MASS LBM=    ,65596      MASS 1/2 CYL LBM=    ,81996       FLANGE MASS=    ,38056

 LIQ VOL FT3=    ,22907        ULLAGE VOL FT3=    ,03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 600,8488    H34= 600,8488    H56= 600,8488    H910= 600,8488    H78=   0,0000

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 600,8488
EST,HT FLUX IN ULLGE (BTU/HR-FT2)=    0,0000
EST,HT INPUT LIQ(STRAT)BTU=    72,695      (STRAT+DESTRAT)BTU=      0,000
EST,LIQ TEMP INCRSE(STRAT)=    14,7983F       (STRAT+DESTRAT)=     0,0000F

EST,HT INPUT ULLAGE(STRAT)BTU=      0,000       (STRAT+DESTRAT)BTU=      0,000
```

Table 5.5-1d. 12 IN. DIA. TANK TEST 1G#20

```
            STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1,5708        CYL AREA FT2=  6,2832        FLNGE AREA FT2=    ,1458
DME WALL VOL FT3=    ,01047      1/2 CYL WALL VOLFT3=    ,01309      FLNGE VOL FT3=    ,00608
DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965       FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=    ,26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 300,4244    H34= 300,4244    H56= 299,5561    H910= 300,4244    H78=   0,0000

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 300.0771
EST,HT FLUX IN ULLGE (BTU/HR-FT2)=    0,0000
EST,HT INPUT LIQ(STRAT)BTU=   589,200      (STRAT+DESTRAT)BTU= 1103,768
EST,LIQ TEMP INCRSE(STRAT)=    15,1119F       (STRAT+DESTRAT)=    29,2792F

EST,HT INPUT ULLAGE(STRAT)BTU=      0,000       (STRAT+DESTRAT)BTU=      0,000
```

Table 5.5-1e. 12 IN. DIA. TANK TEST 1G#22 (Page 3 of 3)

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1.5708        CYL AREA FT2=  6.2832       FLNGE AREA FT2=   .1458
DME WALL VOL FT3=    .01047     1/2 CYL WALL VOLFT3=   .01309    FLNGE VOL FT3=    .00608
DME MASS-LBM=  5.24772      MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

 LIQ VOL FT3=  1.83260        ULLAGE VOL FT3=    .26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12= 300.4244   H34= 300.4244   H56= 299.5561   H910= 300.4244   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 300.0771
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=      0.0000
EST.HT INPUT LIQ(STRAT)BTU=  589.200       (STRAT+DESTRAT)BTU= 1531.920
EST.LIQ TEMP INCRSE(STRAT)=    15.1115F      (STRAT+DESTRAT)=    39.2100F

EST.HT INPUT ULLAGE(STRAT)BTU=      0.000      (STRAT+DESTRAT)BTU=     0.000
```

Table 5.5-2a. 6 IN. DIA TANK TEST 8G #1 (Page 1 of 2)

```
                           TEMPERATURE MATRIX-STRATIFICATION

  TIME(MIN)    0.000     1.000     1.666     2.333     3.000     3.666
 TAU        0.000     .273      .455      .637      .820     1.002
   1        116.417  122.125  125.750  129.000  131.667  134.792
   2        117.042  129.583  133.333  136.500  139.708  142.875
   3        117.417  128.875  132.500  135.375  138.042  140.750
   4        117.417  128.542  131.833  134.458  137.292  139.708
   5        116.958  126.417  129.750  132.167  134.417  136.875
   6        116.833  126.208  129.417  131.792  133.667  136.042
   7        117.083  127.000  129.542  131.375  133.542  135.625
   8        116.958  126.708  128.250  130.333  132.750  134.583
   9        114.792  119.708  121.000  122.500  124.292  126.000
  10        117.167  128.667  132.500  135.458  138.417  141.542
  11        117.333  129.167  132.292  135.125  137.542  140.083
  12        117.375  129.750  131.792  134.208  136.583  138.792
  13        116.667  128.208  129.583  131.042  132.625  134.458
  14        116.417  122.125  125.750  129.000  131.667  134.792
  15        116.625  126.625  130.167  132.500  135.042  137.958
  16        116.833  126.500  130.250  132.500  134.667  137.250
  17        116.417  123.625  126.667  128.875  131.083  133.208
  18        115.833  123.875  125.667  127.625  129.708  131.375
  19        115.292  118.917  120.625  122.458  124.167  125.917
  20        117.167  128.667  132.500  135.458  138.417  141.542
  21        117.333  129.167  132.292  135.125  137.542  140.083
  22        117.375  129.750  131.792  134.208  136.583  138.792
  23        116.667  128.208  129.583  131.042  132.625  134.458
  24        116.208  118.958  121.750  124.333  126.875  129.792
  25        114.833  117.375  119.042  120.750  122.583  124.625
  26        110.333  116.417  117.333  118.125  118.708  119.292
  27        104.833  109.875  111.417  111.333  110.792  110.333
  28        116.000  117.167  118.292  119.500  120.958  122.750
  29        115.958  116.833  118.208  119.792  121.708  123.625
  30        116.292  118.875  121.750  124.458  127.375  130.125
  31        115.167  126.708  127.625  128.125  129.250  130.875
  32        116.500  128.250  129.208  129.417  130.583  132.042
  33        114.500  119.125  120.792  121.583  122.667  124.083
  34        111.917  114.125  115.917  117.417  118.500  119.750
```

Table 5.5-2a. 6 IN. DIA. TANK TEST 8G #1 (Page 2 of 2)

35	108.375	109.792	111.208	112.292	113.292	114.542
36	115.167	126.708	127.625	128.125	129.250	130.875
37	116.375	117.875	119.500	121.208	123.125	125.333
38	116.375	118.458	120.583	122.750	125.042	127.458
39	116.708	119.792	122.542	125.333	128.000	130.875
40	116.833	120.833	124.000	127.000	129.750	132.625
41	117.125	121.042	124.250	127.042	129.792	132.417
42	117.250	121.125	124.333	126.917	130.333	133.083
43	117.583	121.333	124.458	127.292	130.083	132.833
44	117.542	121.792	125.125	128.417	131.625	134.250
45	117.458	121.458	124.292	127.042	130.125	132.542
46	117.250	121.792	125.208	128.167	130.667	133.417
47	117.625	122.375	126.292	129.125	132.125	134.083
48	118.083	121.500	124.458	127.583	130.500	133.417
49	116.167	118.833	121.625	124.917	127.833	130.458
50	116.625	118.958	122.208	125.333	128.208	130.500
51	116.292	118.750	121.333	124.333	126.917	129.250
52	116.896	119.375	122.021	124.667	127.063	129.646
53	115.875	118.458	120.958	124.042	126.375	129.125
54	117.917	120.292	123.083	125.292	127.750	130.167
55	117.667	120.250	122.875	125.708	128.375	130.833
56	117.917	120.292	123.083	125.292	127.750	130.167
57	117.667	120.250	122.875	125.708	128.375	130.833
58	116.833	119.063	121.646	124.313	127.083	129.250
59	117.375	119.375	121.958	124.292	127.250	129.250
60	118.750	120.292	122.875	125.250	127.583	129.833
61	115.625	116.708	118.292	120.292	122.792	124.667
62	115.875	116.542	118.500	120.792	122.875	124.708
63	116.917	117.625	119.375	121.792	123.958	125.792
64	117.917	118.792	120.417	122.333	124.417	125.750
65	115.458	115.542	117.208	118.958	121.000	122.750
66	115.583	115.750	116.583	118.708	119.875	121.250
67	116.542	116.667	117.708	119.417	121.250	122.792
68	117.542	117.917	118.583	120.042	121.458	123.042
69	115.000	115.375	115.958	117.292	119.125	120.417
70	115.292	115.708	116.250	117.458	118.875	120.333
71	115.750	116.375	116.875	118.208	119.750	121.000
72	116.458	117.875	118.417	119.875	121.167	122.667
73	114.542	115.542	117.083	118.333	119.750	121.375
74	106.542	107.708	109.000	110.750	112.500	114.042
75	92.625	92.875	92.917	93.417	94.000	94.208
76	104.042	104.417	104.875	105.875	106.875	107.583
77	89.375	89.292	89.042	89.208	89.292	89.208

Table 5.5-2b. 6 IN. DIA TANK TEST 8G #5 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	,333	1,667	3.000	3,667
TAU	0,000	,091	,455	.818	1,000
1	116,458	118,583	127,208	133.375	136.417
2	116,750	121,708	133,042	139.417	142.208
3	116,917	120,625	131,333	137.292	141,083
4	117,167	121,292	131,417	136.667	139,292
5	116,583	119,833	129,292	134.125	136.500
6	116,583	120,083	129,083	133.250	135,583
7	116,875	120,625	128,875	133.000	135.250
8	116,833	120,875	127,958	132.625	135,167
9	115,542	117,042	121,458	124.708	126,542
10	116,583	123,625	132,042	138.083	141.167
11	116,708	123,708	131,542	136.958	139,500
12	116,875	124,292	131,500	136.375	138,500
13	116,333	123,125	129,333	132.417	134,250
14	115,833	117,333	124,500	130,625	133,708
15	116,042	119,750	129,250	134.500	137,292
16	116,792	121,375	128,708	135.667	137,667
17	115,875	118,750	126,208	130.667	132,833
18	115,333	118,333	125,167	128,875	130,750
19	114,833	115,917	120,167	123,792	125,583
20	116,583	123,625	132,042	138.083	141,167
21	116,708	123,708	131,542	136,958	139,500
22	116,875	124,292	131,500	136.375	138,500
23	116,333	123,125	129,333	132.417	134,250
24	115,917	116,417	122,125	127.750	130,792
25	115,708	116,042	120,500	125.250	127,917
26	115,292	115,958	120,042	124.458	126,875
27	112,583	115,750	119,333	122,625	124,333
28	116,042	116,250	119,417	123,583	126,042
29	115,667	115,625	118,958	123.458	126,000
30	115,708	116,167	122,042	127.875	130,792
31	115,972	122,514	127,722	129.458	131,111
32	116,583	123,125	128,917	130,125	131,833
33	114,542	115,792	120,083	121.792	123,250
34	110,625	110,917	114,125	116.417	117,542

Table 5.5-2b. 6 IN. DIA TANK TEST 8G #5 (Page 2 of 2)

35	106,208	106,208	108,208	110,125	111,250
~~36~~	~~115,667~~	~~122,208~~	~~127,125~~	~~129.125~~	~~13 ,750~~
37	116,000	116,625	120,667	125.333	127,958
38	116,000	116,500	121,542	126.875	129,625
~~39~~	~~116,250~~	~~116,958~~	~~122,833~~	~~128.542~~	~~131,417~~
40	116,458	117,250	123,625	129.417	132,292
41	116,500	118,208	124,542	130,000	133,000
~~42~~	~~116,458~~	~~118,083~~	~~124,208~~	~~130,083~~	~~133,000~~
43	116,458	117,917	124,833	130,625	133,000
44	116,750	118,292	124,792	130.583	133,500
~~45~~	~~116,417~~	~~117,917~~	~~125,167~~	~~130.042~~	~~132,875~~
46	116,792	118,250	124,833	130.500	133,542
47	117,167	119,417	125,958	131.292	134,375
~~48~~	~~117,583~~	~~118,250~~	~~123,792~~	~~129.833~~	~~132,875~~
49	116,083	116,083	121,833	127.625	13 ,042
50	116,375	116,583	121,875	127.583	13 ,542
~~51~~	~~116,042~~	~~116,208~~	~~121,167~~	~~126.708~~	~~129,083~~
52	116,729	116,958	121,979	127.125	129.459
53	116,042	116,000	121,167	126.333	128.583
~~54~~	~~117,417~~	~~117,708~~	~~122,792~~	~~127.542~~	~~129,833~~
55	117,167	117,500	122,583	128.042	13 ,417
56	117,417	117,708	122,792	127.542	129,833
~~57~~	~~117,167~~	~~117,500~~	~~122,583~~	~~128.042~~	~~13 ,417~~
58	115,958	115,917	121,042	125.875	128.167
59	116,875	117,208	121,375	126.250	128.583
~~60~~	~~118,333~~	~~118,292~~	~~122,292~~	~~127.292~~	~~129,542~~
61	115,500	115,625	117,958	122.625	124.833
62	115,667	115,833	118,208	122.167	123.958
~~63~~	~~116,458~~	~~116,625~~	~~119,458~~	~~123.875~~	~~125,708~~
64	117,625	117,625	120,167	123.583	125,667
65	115,375	115,667	116,875	120.708	122,583
~~66~~	~~115,500~~	~~115,667~~	~~116,583~~	~~119.792~~	~~121,333~~
67	116,125	116,458	117,292	120.667	122,375
68	117,208	117,208	117,917	12 .875	122,208
~~69~~	~~115,208~~	~~115,292~~	~~115,667~~	~~118.833~~	~~12 ,208~~
70	115,417	115,583	116,000	118.833	120,208
71	115,750	116,083	116,542	119.292	12 ,792
~~72~~	~~116,500~~	~~117,042~~	~~118,208~~	~~12 .917~~	~~122,292~~
73	114,542	115,250	116,583	119.208	12 ,792
74	106,833	107,208	109,208	112.417	114.167
~~75~~	~~92,708~~	~~92,875~~	~~92,917~~	~~93.792~~	~~94,083~~
76	104,292	104,417	105,167	106.958	107,917
77	90,417	90,500	89,917	90,000	89,958

Table 5.5-2c. 6 IN. DIA TANK TEST 8G #8S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

~~TIME(MIN)~~	~~0.000~~	~~.333~~	~~1.000~~	~~3.000~~	~~3.667~~
TAU	0.000	.091	.273	.818	1.000
1	117,708	119,833	123,917	133,458	136,083
~~2~~	~~118,417~~	~~122,917~~	~~129,667~~	~~139,000~~	~~141,875~~
3	118,458	122,042	128,042	136,958	139,500
4	118,333	122,167	128,042	136,375	138,792
~~5~~	~~117,875~~	~~120,250~~	~~126,250~~	~~133,667~~	~~135,833~~
6	117,000	119,917	125,750	132,500	134,792
7	117,625	119,958	127,208	131,375	134,125
~~8~~	~~115,917~~	~~120,042~~	~~124,875~~	~~132,000~~	~~134,375~~
9	114,250	115,708	116,208	123,958	125,625
10	117,750	124,792	128,875	137,833	140,583
~~11~~	~~116,958~~	~~123,917~~	~~128,667~~	~~136,542~~	~~138,958~~
12	115,958	123,083	126,292	135,542	137,625
13	115,292	121,667	126,125	131,333	133,042
~~14~~	~~116,625~~	~~118,125~~	~~121,375~~	~~130,000~~	~~132,542~~
15	117,375	120,958	125,583	134,042	136,583
16	118,583	121,333	126,233	134,000	136,042
~~17~~	~~116,417~~	~~119,042~~	~~123,292~~	~~130,000~~	~~131,958~~
18	114,708	117,792	122,125	128,167	129,792
19	114,125	114,875	117,083	122,667	124,292
~~20~~	~~117,750~~	~~124,792~~	~~128,875~~	~~137,833~~	~~140,583~~
21	116,958	123,917	128,667	136,542	138,958
22	115,958	123,083	126,292	135,542	137,625
~~23~~	~~115,292~~	~~121,667~~	~~126,125~~	~~131,333~~	~~133,042~~
24	115,792	116,167	118,375	126,333	128,875
25	114,042	116,083	117,375	123,125	125,167
~~26~~	~~107,167~~	~~108,292~~	~~111,125~~	~~116,375~~	~~117,375~~
27	100,250	100,500	104,875	109,625	109,583
28	115,458	115,542	117,000	121,333	123,167
29	115,667	115,792	116,667	121,708	123,792
30	116,292	116,750	118,583	126,542	129,292
31	114,750	120,903	124,583	128,292	129,847
~~32~~	~~115,667~~	~~121,708~~	~~125,417~~	~~128,958~~	~~130,458~~
33	113,542	115,125	117,750	121,292	122,542
34	113,000	113,083	114,333	117,625	118,625

Table 5.5-2c. 6 IN. DIA TANK TEST 8G #8S (Page 2 of 2)

~~35~~	~~111,917~~	~~111,833~~	~~112,000~~	~~114,000~~	~~114,500~~
36	114,292	120,500	124,083	127,958	129,542
37	116,167	116,542	117,792	123,375	125,458
~~38~~	~~116,250~~	~~116,333~~	~~118,417~~	~~125,042~~	~~127,542~~
39	116,542	117,292	119,208	127,375	129,917
40	117,000	117,833	120,333	128,750	131,375
~~41~~	~~117,000~~	~~118,125~~	~~120,875~~	~~130,625~~	~~133,000~~
42	117,083	118,083	120,875	130,500	133,125
43	117,208	118,375	121,083	131,042	133,417
~~44~~	~~117,458~~	~~118,667~~	~~122,125~~	~~130,708~~	~~133,417~~
45	117,333	118,375	121,208	130,917	133,125
46	117,417	119,125	122,125	130,833	133,542
~~47~~	~~118,500~~	~~120,125~~	~~123,000~~	~~131,542~~	~~134,750~~
48	116,729	117,104	119,750	122.563	131,021
49	116,458	116,083	118,625	126.500	129,042
~~50~~	~~116,875~~	~~116,667~~	~~118,708~~	~~126,750~~	~~129,417~~
51	116,625	116,458	118,167	126,042	128,292
52	117,375	117,250	119,167	126,563	128,771
~~53~~	~~115,792~~	~~115,917~~	~~118,208~~	~~125,833~~	~~127,792~~
54	118,125	118,042	120,167	127,083	129,250
55	117,875	117,542	119,667	127,542	129,833
~~56~~	~~118,125~~	~~118,042~~	~~120,167~~	~~127,083~~	~~129,250~~
57	117,875	117,542	119,667	127,542	129,833
58	115,958	116,167	118,125	125,083	127,333
~~59~~	~~117,000~~	~~117,083~~	~~118,333~~	~~126,000~~	~~127,958~~
60	118,208	118,417	119,792	126,958	129,167
61	114,542	114,292	115,250	121,667	123,208
~~62~~	~~114,250~~	~~114,333~~	~~115,333~~	~~121,500~~	~~123,375~~
63	115,375	115,375	116,500	122,667	124,583
64	116,417	116,625	118,042	122,875	124,542
~~65~~	~~113,083~~	~~113,167~~	~~114,208~~	~~119,250~~	~~121,208~~
66	113,250	113,042	114,042	118,292	119,917
67	114,292	114,042	115,042	119,708	121,125
~~68~~	~~115,542~~	~~115,292~~	~~115,917~~	~~119,625~~	~~121,125~~
69	112,917	112,708	113,167	117,208	118,750
70	113,292	113,000	113,458	117,292	118,833
~~71~~	~~113,917~~	~~113,833~~	~~114,292~~	~~118,083~~	~~118,750~~
72	115,292	115,292	115,958	119,750	121,417
73	112,917	113,250	113,875	117,917	119,375
~~74~~	~~109,208~~	~~109,500~~	~~110,667~~	~~116,083~~	~~117,917~~
75	95,833	95,917	96,458	99,000	99,917
76	103,667	103,500	103,708	106,208	106,708
~~77~~	~~87,458~~	~~87,292~~	~~87,292~~	~~87,417~~	~~87,250~~

Table 5.5-2d. 12 IN. DIA TANK TEST 1G #20 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	2,000	4,000	6,000	9,000	12,000	13,000	15,000
TAU	0,000	,133	,267	,400	,600	,800	,867	1,000
1	117,125	121,292	123,342	125,542	129,250	131,042	131,917	133,750
2	117,125	123,000	125,708	127,583	130,333	133,042	134,000	135,625
3	117,500	124,042	126,458	128,250	130,792	133,625	134,375	135,208
4	117,583	123,792	126,042	127,750	130,042	132,750	133,542	135,333
5	117,458	123,792	125,958	127,708	130,000	132,500	133,417	135,125
6	117,417	122,583	124,458	125,875	128,250	130,667	131,500	133,167
7	117,500	122,583	124,167	125,458	127,500	129,917	130,667	132,292
8	117,458	122,958	124,375	125,542	127,583	129,875	130,500	131,958
9	117,167	119,875	121,458	122,917	125,042	127,250	127,917	129,417
10	117,333	128,625	131,167	132,833	135,708	138,250	139,208	141,000
11	117,417	128,792	131,042	132,792	135,167	137,750	138,583	140,750
12	117,583	127,417	129,208	130,667	132,875	135,333	136,083	137,583
13	117,417	127,958	129,458	130,667	132,667	134,750	135,667	137,042
14	116,750	121,125	123,292	125,208	129,042	130,750	131,625	133,542
15	117,292	126,750	129,250	131,208	133,750	137,000	138,042	139,583
16	117,500	126,042	128,458	130,292	132,667	135,208	136,208	138,042
17	117,292	125,458	127,333	128,875	131,042	133,458	134,583	135,000
18	117,208	124,625	126,375	127,750	129,708	131,917	132,500	134,208
19	116,875	119,292	120,792	122,167	124,167	126,375	127,125	128,667
20	117,583	128,792	131,125	132,917	135,542	138,417	139,125	141,125
21	117,458	129,167	131,250	133,042	135,333	137,708	138,750	140,458
22	117,333	127,625	129,167	130,708	132,875	135,333	136,083	137,917
23	117,458	127,750	129,000	130,375	132,375	134,583	135,250	136,667
24	116,500	118,083	119,917	121,667	124,167	126,708	127,542	129,167
25	116,083	117,292	118,667	120,000	121,958	124,000	124,667	126,125
26	115,875	117,042	118,292	119,417	121,125	122,750	123,417	124,583
27	115,833	116,917	118,042	118,917	120,125	121,333	121,708	122,417
28	116,042	116,875	117,917	119,083	120,833	122,750	122,583	124,750
29	115,875	116,792	118,042	119,333	121,208	123,250	123,958	125,417
30	116,375	117,958	119,792	121,542	124,000	126,458	127,333	128,917
31	117,667	127,958	129,417	130,542	132,500	134,625	135,333	136,917
32	117,375	126,958	128,125	129,292	131,250	133,333	134,042	[illegible]
33	115,333	119,042	120,333	121,250	122,792	124,500	125,167	126,417
34	114,958	114,750	114,750	114,792	115,083	115,625	115,875	116,458

Table 5.5-2d. 12 IN. DIA TANK TEST 1G #20 (Page 2 of 2)

35	114,750	114,083	113,458	112,958	112,417	112,000	112,000	111,875
36	118,000	128,250	129,625	130,833	132,667	134,750	135,542	137,000
37	116,375	117,625	119,000	120,417	122,375	124,417	125,125	126,667
38	116,500	117,958	119,625	121,167	123,458	125,708	126,500	128,083
39	116,708	118,458	120,250	122,042	124,583	127,042	127,917	129,667
40	116,917	118,833	120,875	122,792	125,542	128,167	129,083	130,833
41	117,458	118,917	120,708	122,292	125,083	127,542	128,958	130,250
42	117,583	119,083	121,000	122,792	125,542	128,208	128,958	130,958
43	117,667	119,042	121,125	123,000	125,625	128,292	129,125	130,792
▼44	117,792	119,208	120,375	122,708	125,375	128,208	129,125	130,792
45	117,667	119,250	120,583	122,458	125,083	127,833	128,833	130,542
46	117,458	119,542	121,500	123,458	126,500	128,917	129,750	131,708
47	117,667	119,333	121,333	123,417	125,958	128,542	129,333	131,167
48	117,958	119,292	121,333	123,125	125,750	128,417	129,333	131,125
49	117,833	119,083	120,958	122,708	125,208	127,833	128,833	130,500
50	117,708	118,917	120,583	122,042	124,625	127,250	128,292	129,875
51	117,833	118,625	119,667	121,208	123,708	126,250	127,208	125,958
52	117,792	118,792	120,333	122,083	124,625	127,167	128,125	129,875
53	117,625	118,917	120,792	122,458	124,917	127,625	128,208	130,000
54	117,792	118,875	120,542	122,208	124,667	127,167	128,167	129,875
55	117,792	118,792	120,50[illegible]	122,250	124,708	127,000	128,042	129,833
56	117,708	118,750	120,333	122,042	124,625	127,125	128,125	129,833
57	117,667	118,917	120,500	122,208	124,792	127,083	128,20[illegible]	129,958
58	117,833	118,750	120,125	121,917	124,375	126,917	127,833	12[illegible],667
59	117,667	118,500	119,917	121,542	124,083	126,167	127,250	129,000
60	117,583	118,292	119,792	121,417	123,625	126,042	127,125	128,792
61	117,750	118,250	119,333	120,625	123,083	125,250	126,375	127,875
62	117,750	118,208	119,417	120,792	123,042	125,375	126,292	127,333
63	117,625	118,042	119,292	120,667	122,833	124,958	126,000	127,667
64	117,583	117,958	119,083	120,250	122,292	124,875	125,500	127,000
65	117,583	117,958	119,042	120,292	122,542	124,500	125,500	127,083
66	117,583	117,833	118,708	119,792	121,875	123,917	124,833	126,333
67	117,583	117,833	118,708	119,792	121,875	123,917	124,833	126,333
68	117,542	117,708	118,500	119,583	121,500	123,458	124,333	125,792
69	117,583	117,708	118,583	119,667	121,625	123,500	124,375	125,958
70	117,458	117,667	118,417	119,375	121,375	123,208	124,208	125,625
71	117,458	117,667	118,417	119,375	121,375	123,208	124,208	125,625
72	117,542	117,792	118,417	119,500	121,292	123,333	124,167	125,667
73	117,500	117,625	118,375	119,458	121,458	123,250	124,250	125,708
74	92,042	92,250	92,458	92,667	93,208	93,750	94,167	94,667
75	103,458	103,625	103,958	106,208	105,708	106,917	107,583	108,625
76	80,875	81,083	81,958	82,083	82,292	82,292	82,583	82,750
77	91,542	91,792	91,958	92,167	92,792	93,250	93,750	95,500

Table 5.5-2e. 12 IN. DIA TANK TEST 1G #22 (Page 1 of 2)

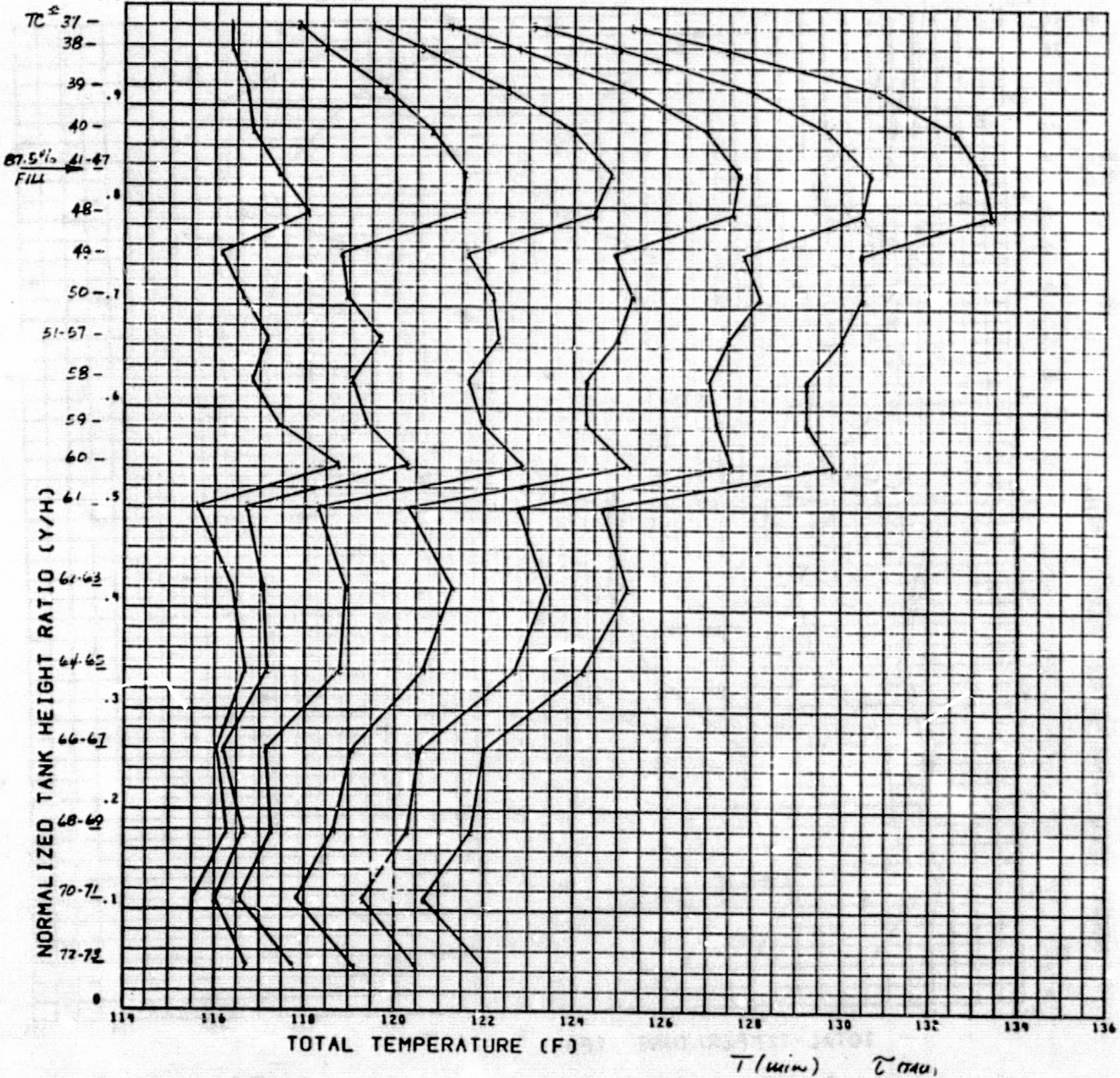
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	2.000	6.000	9.000	12.000	15.000
TAU	0.000	.133	.400	.600	.800	1.000
1	116,875	121,042	125,458	128,167	130,958	133,625
2	116,875	122.958	127,458	130,417	133,042	135,792
3	117,250	123.625	128,125	130,958	133,667	136,250
4	117,458	123.750	127,667	130,167	133,000	135,417
5	117,208	123.958	128,083	130,458	133,083	135,708
6	117,208	122.792	126,292	128,667	131,125	133,708
7	117,292	122.667	125,667	127,917	130,375	132,875
8	117,458	123.125	126,042	128,000	130,333	132,750
9	117,125	119,917	123,208	125,458	127,708	129,958
10	117,042	128,750	132,667	135,583	138,417	141,042
11	117,208	128,750	132,500	135,125	137,667	140,333
12	117,417	127.708	131,083	133,583	136,125	138,625
13	117,167	128,917	131,292	133,250	135,458	138,083
14	116,667	121,033	125,208	127,958	130,667	133,375
15	117,083	127.125	131,292	134,375	137,000	139,875
16	117,250	126.417	130,542	133,125	135,750	138,250
17	117,167	126.417	129,792	132,083	134,583	137,208
18	116,958	125.292	128,583	130,667	132,958	135,500
▼ 19	116,583	119.375	122,417	124,625	126,792	129,042
20	117,333	129.042	133,000	135,917	138,458	141,250
21	117,167	128.708	132,708	135,375	137,750	140,542
22	117,250	127.833	131,083	133,583	136,000	138,542
23	117,292	128.208	130,750	132,958	135,042	137,458
24	116,625	117.875	121,625	124,333	126,958	129,667
25	116,250	117.292	120,333	122,750	125,208	127,792
26	116,042	117.125	120,125	122,375	124,792	127,292
27	116,083	117.167	119,917	122,167	124,417	126,833
28	116,458	117.167	119,583	121,792	124,167	126,583
29	116,167	116.958	119,708	122,083	124,500	127,042
30	116,333	117.667	121,417	124,125	126,750	129,458
31	117,417	127.583	130,417	132,500	134,625	137,083
32	117,125	126.500	129,083	131,083	133,167	135,500
33	114,708	118.500	120,750	122,292	124,083	126,000
34	114,125	113.708	113,750	114,042	114,500	115,125

Table 5.5-2e. 12 IN. DIA TANK TEST 1G #22 (Page 2 of 2)

35	113,633	113.042	111,792	111.125	110,667	110,375
36	117,792	127,875	130,667	132,833	134,917	137,208
37	116,625	117,625	120,667	123,083	125,542	128,083
38	116,708	117,833	121,292	123,792	126,375	129,000
39	116,833	118.208	121,917	124,708	127,292	130,000
40	117,000	118.750	122,583	125,542	128,208	130,750
41	117,333	118.625	122,250	124,875	127,500	130,250
42	117,333	118.833	122,708	125,417	128,083	130,833
43	117,375	119.000	122,750	125,500	128,208	130,833
44	117,625	118.917	122,500	125,292	127,958	130.750
45	117.458	118.792	122,208	124.792	127,625	130,250
46	117,292	119.167	123,167	125,875	128,667	131,458
47	117,583	118.875	122,875	125,667	128,500	131,250
48	117,792	119.125	122,958	125.667	128,292	131,083
49	117,646	118.896	122,583	125,208	127,771	130,500
50	117,500	118,667	122,208	124,750	127,250	129,917
51	117,625	118.417	121,000	123,667	126,167	129,167
52	117,583	118,667	121,875	124,583	127,167	130,083
53	117,375	118,833	122,167	124,875	127,417	130,500
54	117,625	118.750	122,167	124,875	127,375	130,000
55	117,667	118.583	122,167	124,875	127,208	130,208
56	117,625	118,750	121,833	124,625	127,125	130,042
57	117,500	118,875	122,083	124,833	127,167	130,083
58	117,708	118,583	121,708	124,458	127,042	129,875
59	117,500	118,333	121,375	124,083	126,583	129,375
60	117,375	118,167	121,292	123,958	126,000	129,000
61	117,458	118,083	120,583	123,042	125,458	128,375
62	117,625	118.167	120,833	123,333	125,417	127,875
63	117,375	117.958	120,500	123,167	125,167	128,042
64	117,292	117.792	120,208	122,583	124,708	127,375
65	117,292	117,792	120,125	122,625	124,833	127,417
66	117,333	117.681	119,736	122,028	124,069	126,694
67	117,333	117.708	119,625	121,958	123,958	126,625
68	117,375	117,542	119,375	121,542	123,542	126,083
69	117,333	117.625	119,417	121,667	123,500	126,125
70	117,276	117.597	119,264	121,403	123,375	125,958
71	117,250	117.542	119,083	121,292	123,292	125,917
72	117,208	117.708	119,333	121,375	123,292	125,875
73	117,375	117.625	119,125	121,417	123,542	126,000
74	92,833	•93.000	92,917	93,458	93,792	94,750
75	104,417	104.625	105,125	106,292	107,208	109.000
76	85,042	85.060	84,625	84,792	84,542	84,958
77	97.000	97.000	96,917	97,333	97.542	98,375

FIGURE 5.5-1a
6 IN. TNK TEST 8GΣ1 – STRAT TEMPERATURE PROFILE

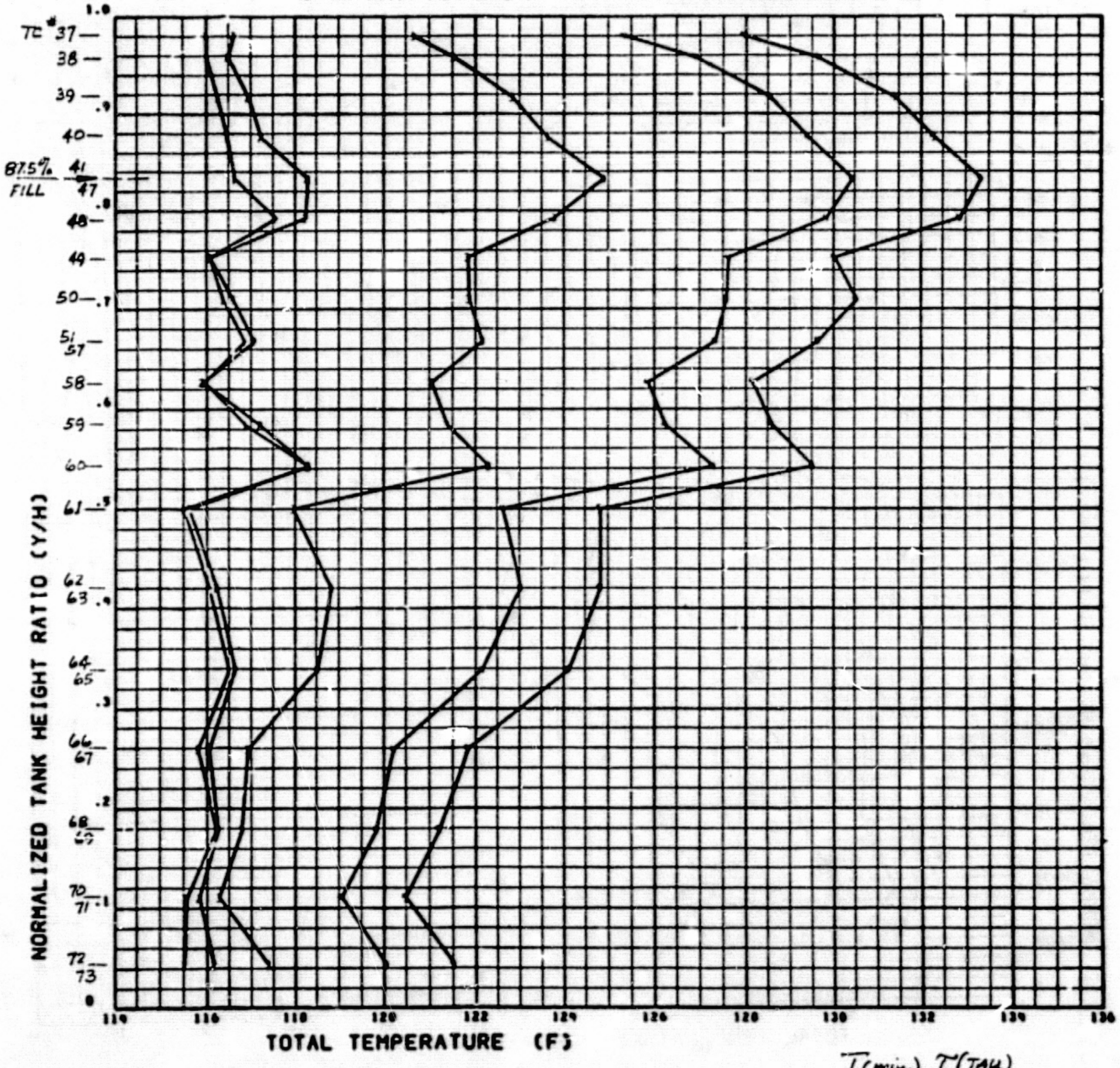


$q''_H = 600$ BTU/hr ft²

LIQ HT'G ONLY

	T (min)	τ (TAU)
1	0.	0.
2	1.	.273
3	1.666	.455
4	2.333	.637
5	3.	.82
6	3.666	1.002

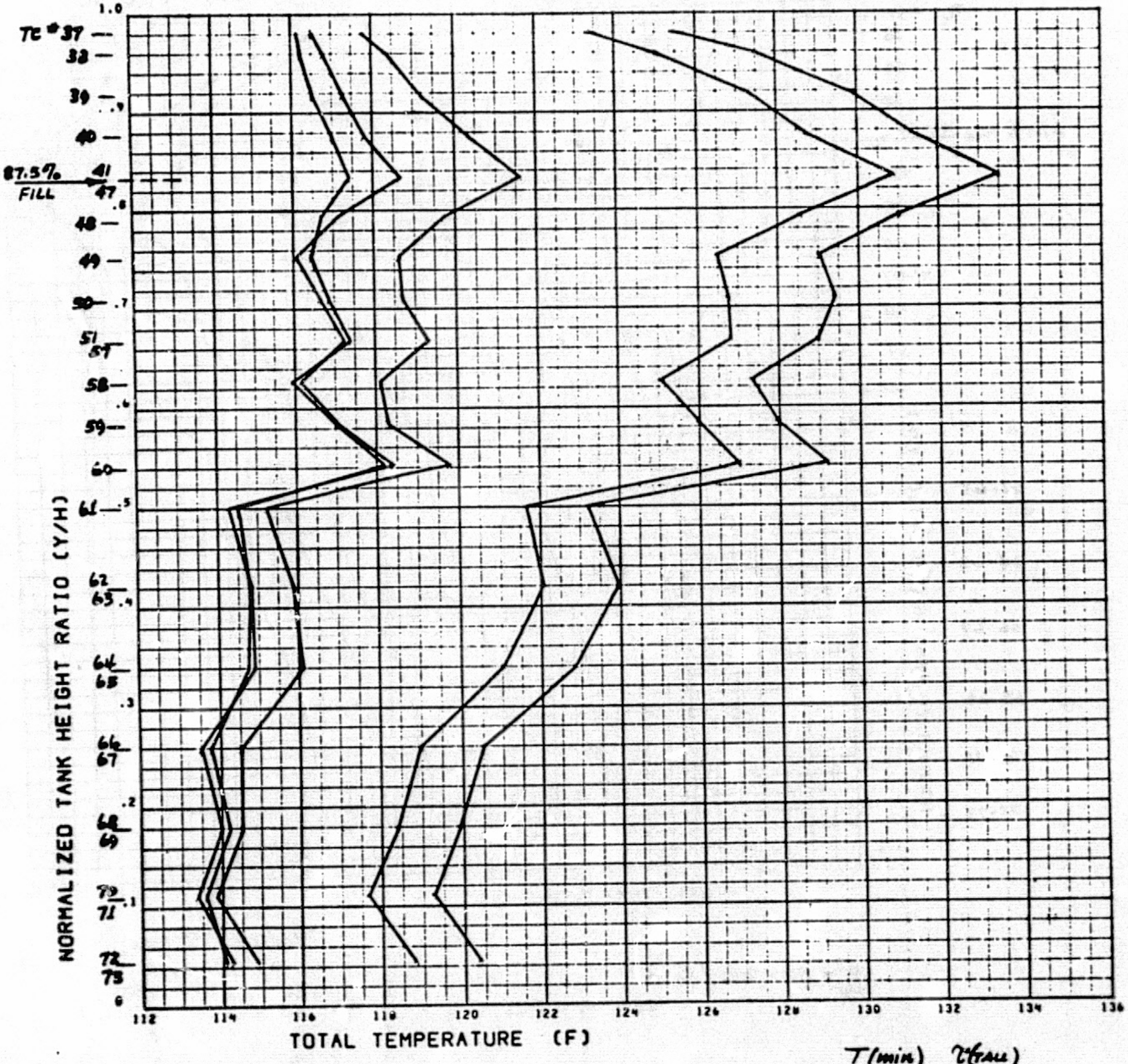
FIGURE 5.5-1b
6 IN. TNK TST8G5 STRAT TEMPERATURE PROFILE



q''_{0_H} = 600 BTU/hr ft² LIQ HTG

	T(min)	τ(TAU)
1	0.	0.
2	.333	.091
3	1.667	.455
4	3.	.818
5	3.667	1.000

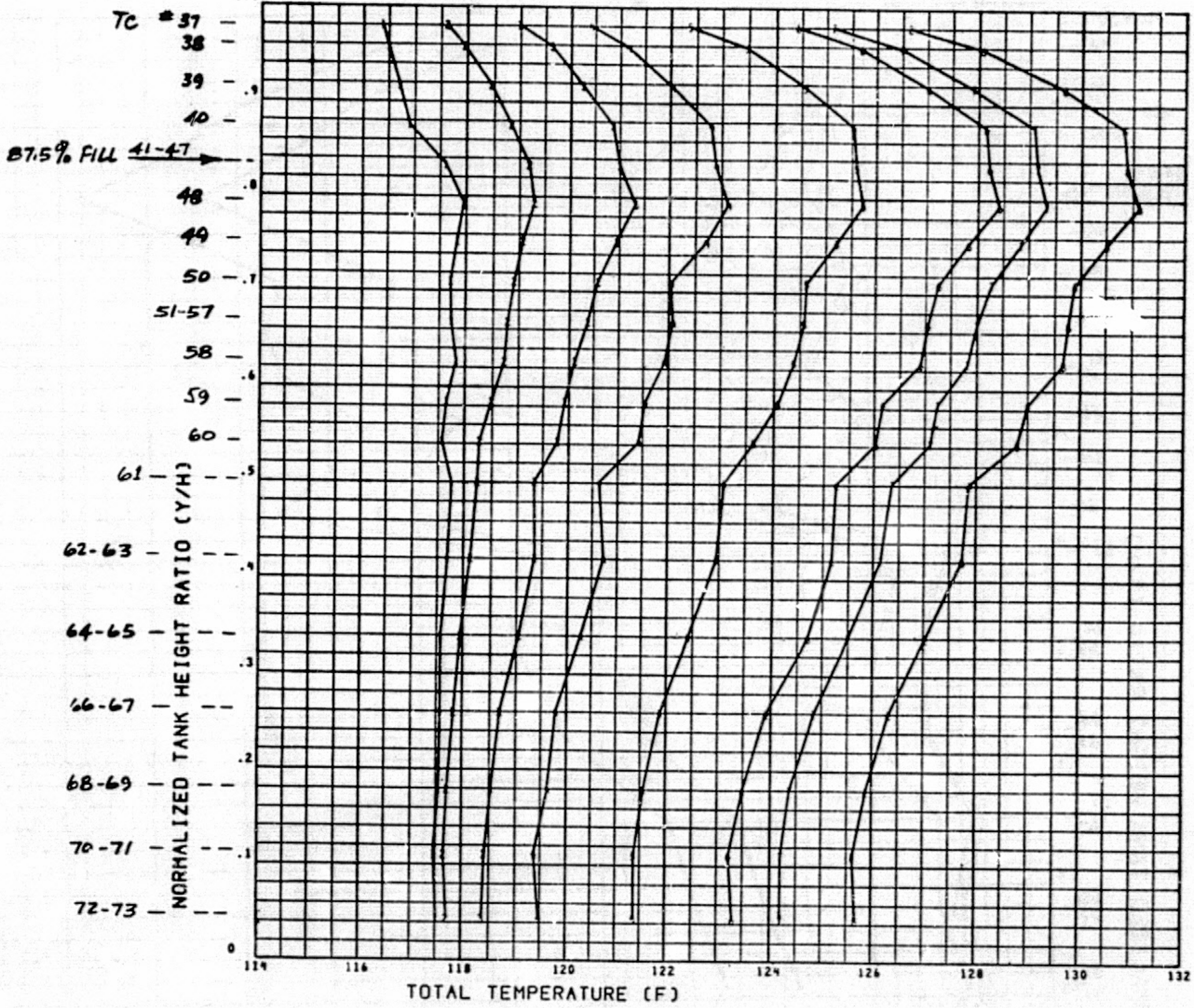
FIGURE 5.5-1c
6 IN. TNK TST8GΣ8S STRAT TEMPERATURE PROFILE



q''_W = 600 BTU/hr ft² LIQ HTG

	T(min)	τ(frac)
1	0.	0.
2	.333	.091
3	1.	.273
4	3.	.818
5	3.667	1.000

FIGURE 5.5-1d
12 IN. TNK TEST 1GΣ20 – STRAT TEMPERATURE PROFILE

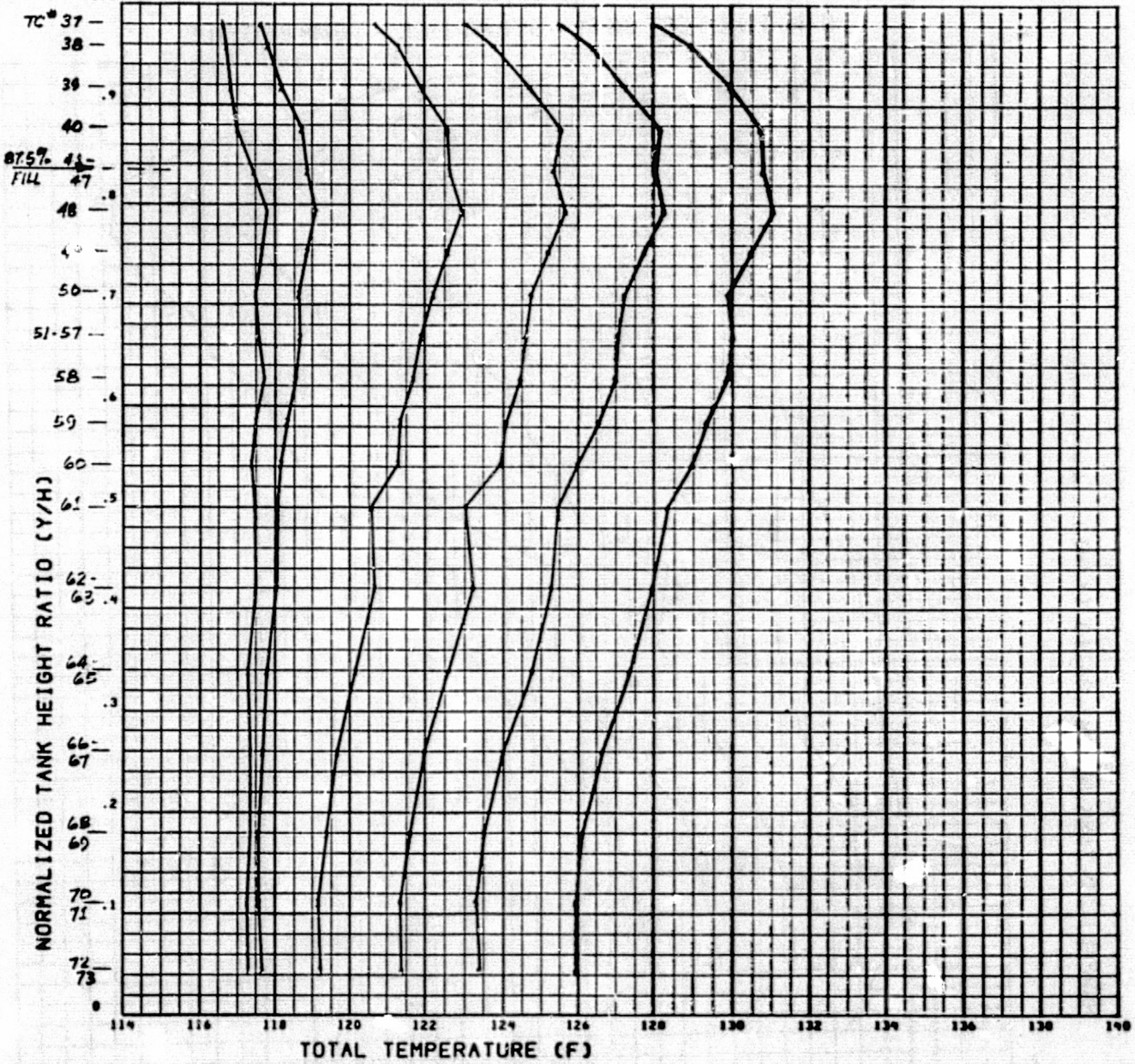


q''_H = 300 BTU/hr ft²

LIQ HT'G ONLY

	T (min)	τ (TAU)
1	0.0	0.0
2	2.	.133
3	4.	.267
4	6.	.4
5	9.	.6
6	12.	.8
7	13.	.867
8	15.	1.0

FIGURE 5.5-1e
12 IN. TNK TST1G22 STRAT TEMPERATURE PROFILE



$\dot{q}''_H = 300$ BTU/hr ft² LIQ HT'G

	T(min)	τ(TAU)
1	0.	0.
2	2.	.133
3	6.	.4
4	9.	.6
5	12.	.8
6	15.	1.000

FIGURE 5.5-2a

6 IN. TNK TEST 8GΣ1 – STRAT DEL – TEMP PROFILE

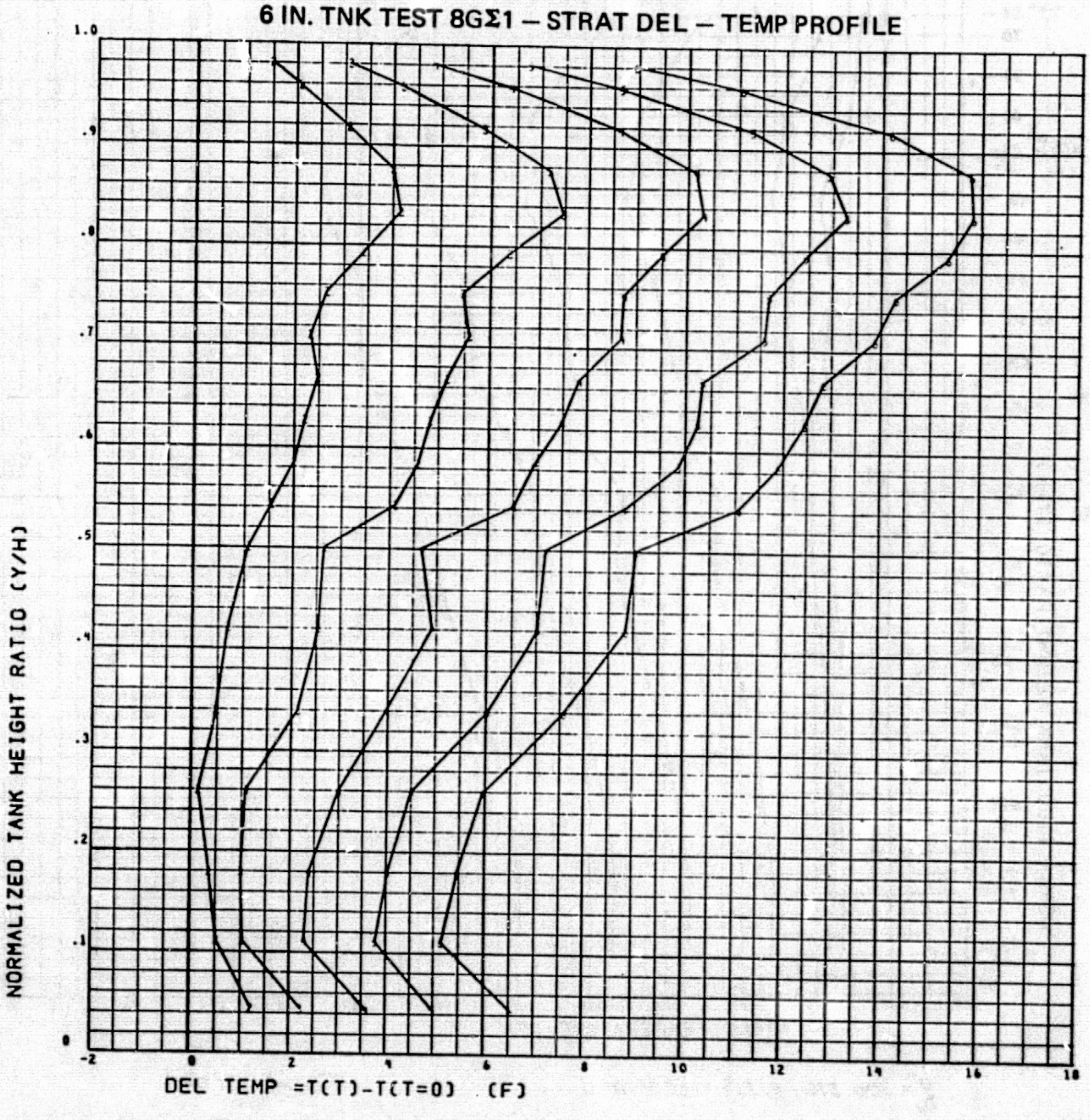


FIGURE 5.5-2b
6 IN. TNK TST8G5 STRAT DEL – TEMP PROFILE

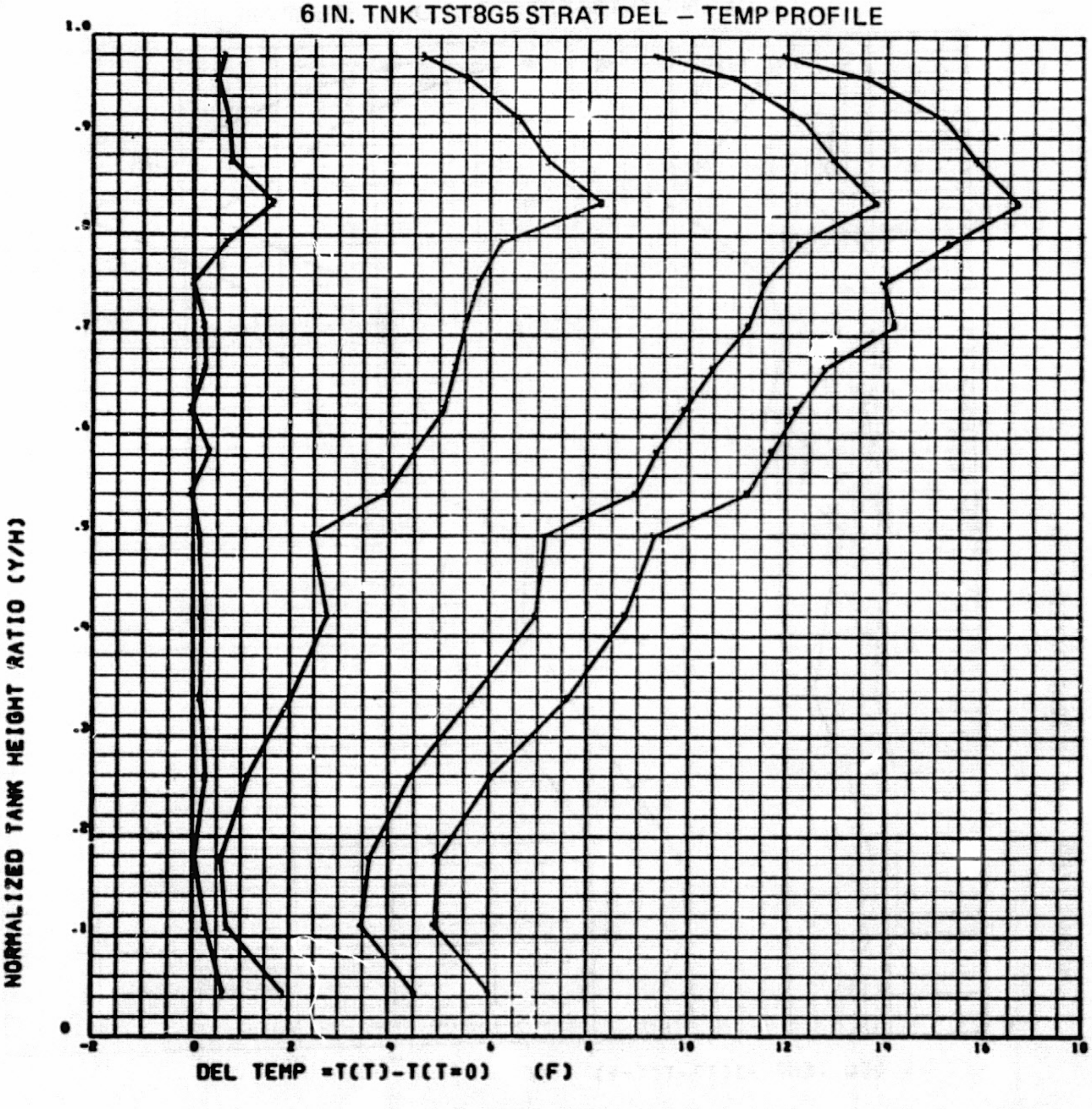


FIGURE 5.5-2c

6 IN. TNK TST8GΣ8S STRAT DEL – TEMP PROFILE

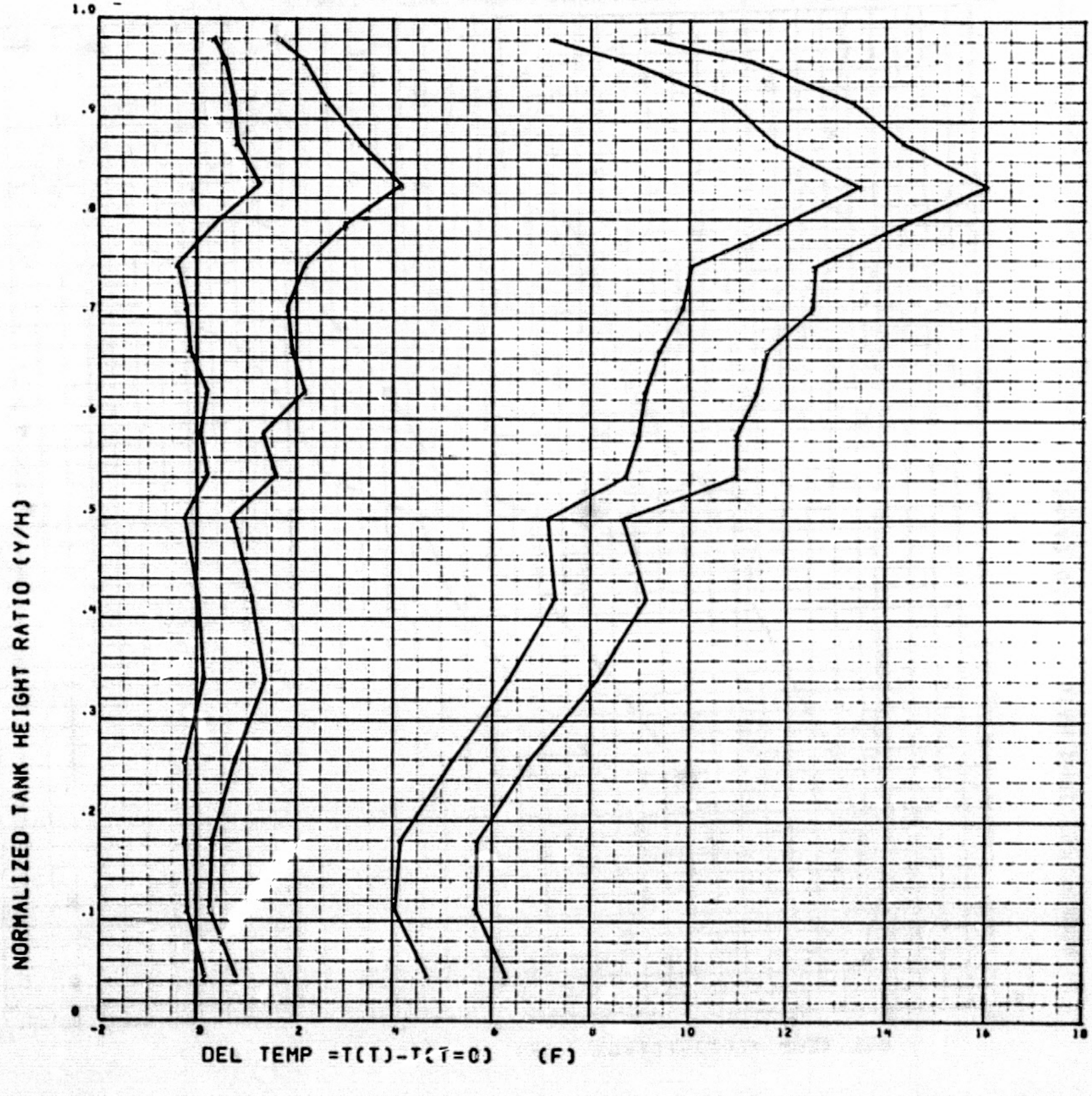


FIGURE 5.5-2d
12 IN. TNK TEST 1GΣ20 – STRAT DEL – TEMP PROFILE

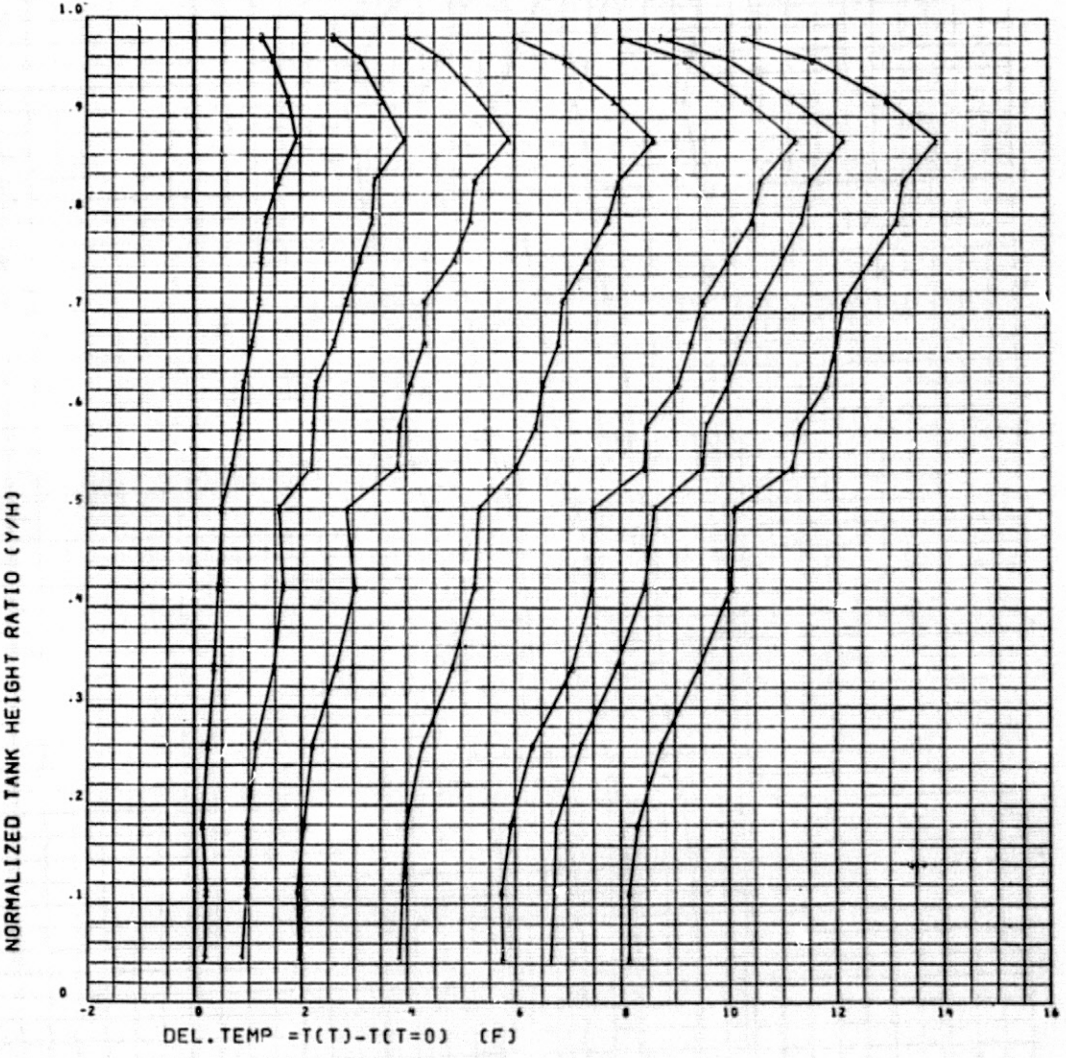


FIGURE 5.5-2e

12 IN. TNK TST1G22 STRAT DEL — TEMP PROFILE

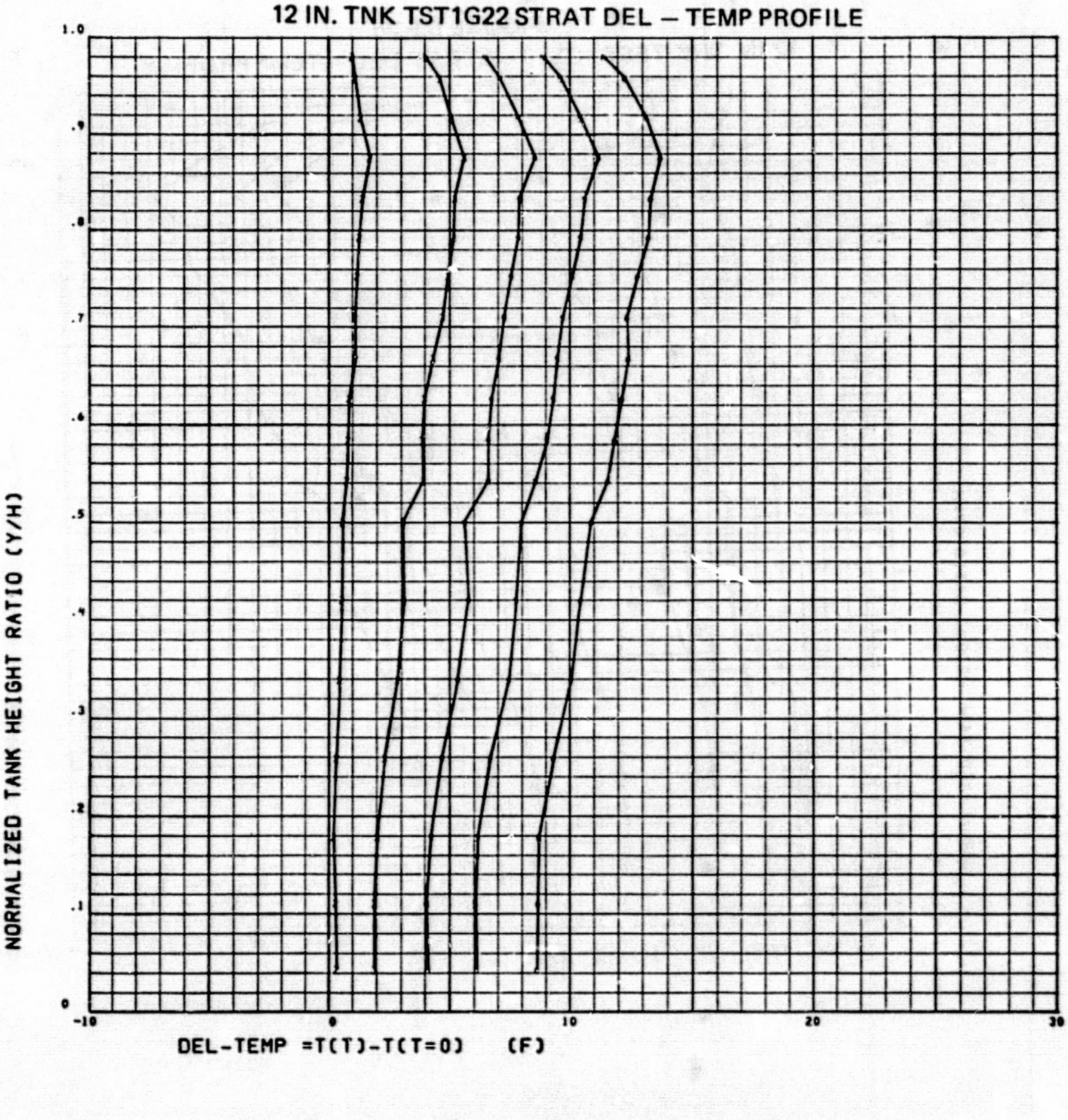


FIGURE 5.5-3a

6 IN. TNK TEST 8GΣ1 – STRAT DTNORM PROFILE

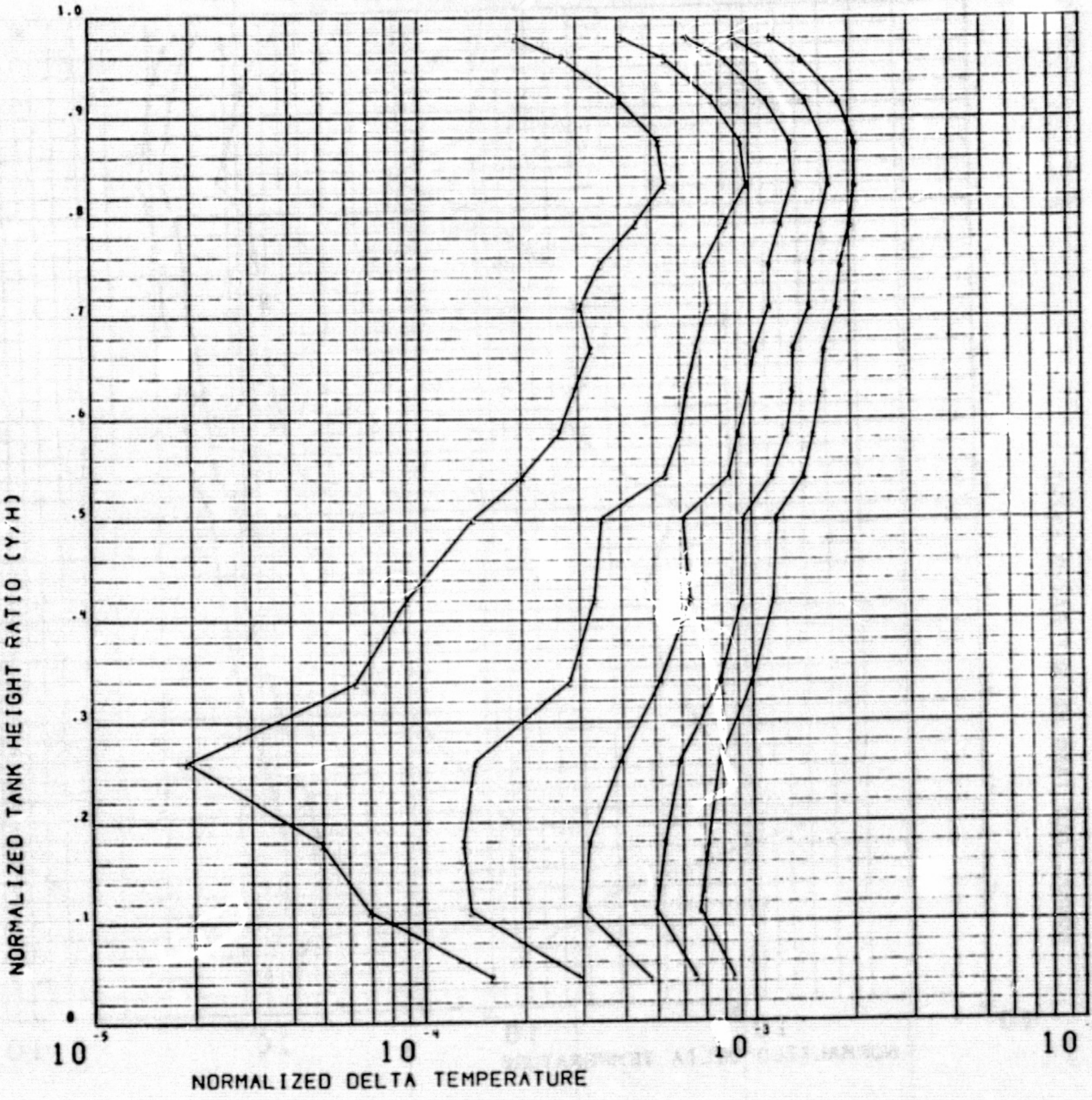


FIGURE 5.5-3b

6 IN. TNK TST8G5 STRAT DTNORM PROFILE

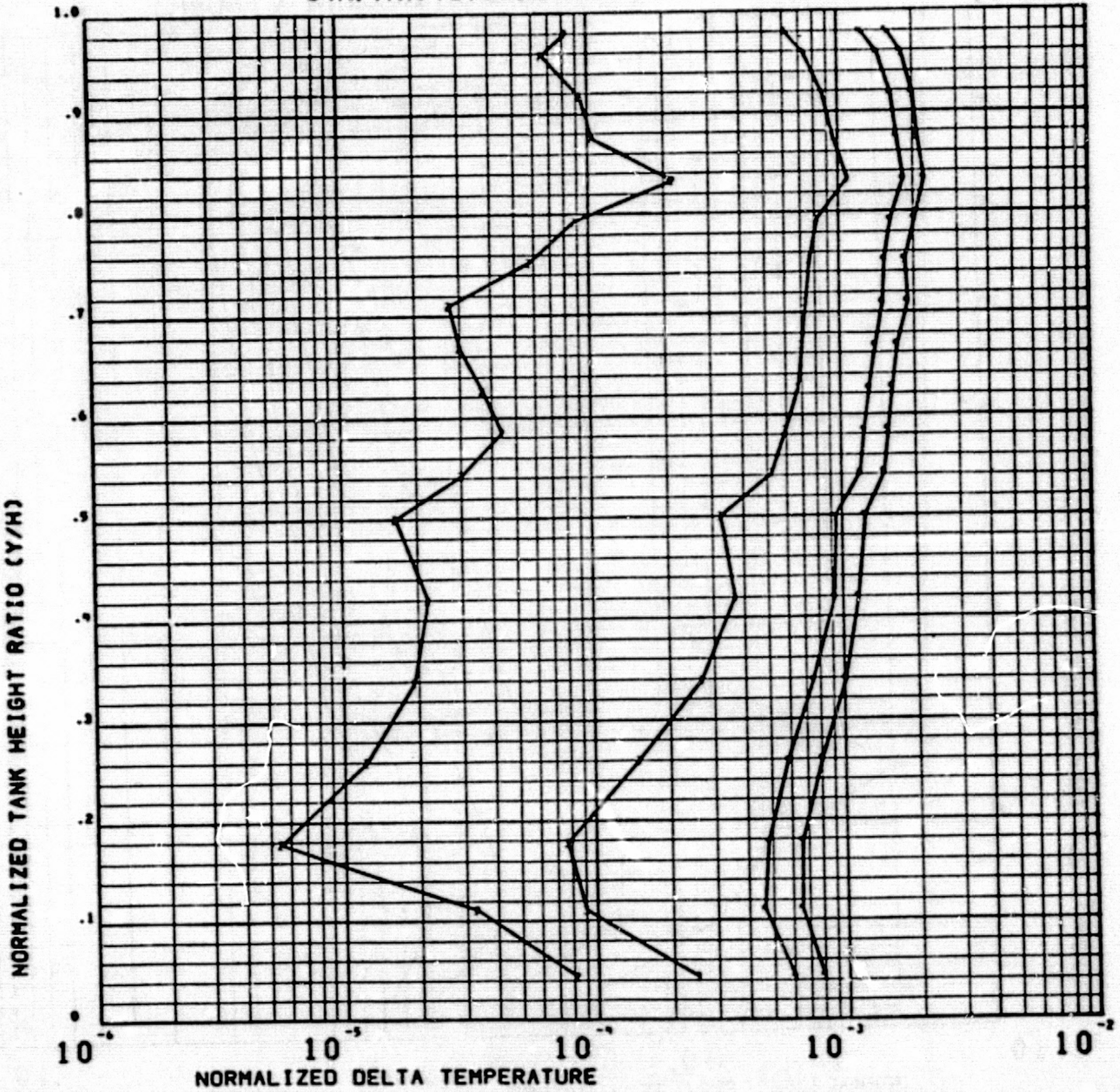


FIGURE 5.5-3c
6 IN. TNK TST8GΣ8S STRAT DTNORM PROFILE

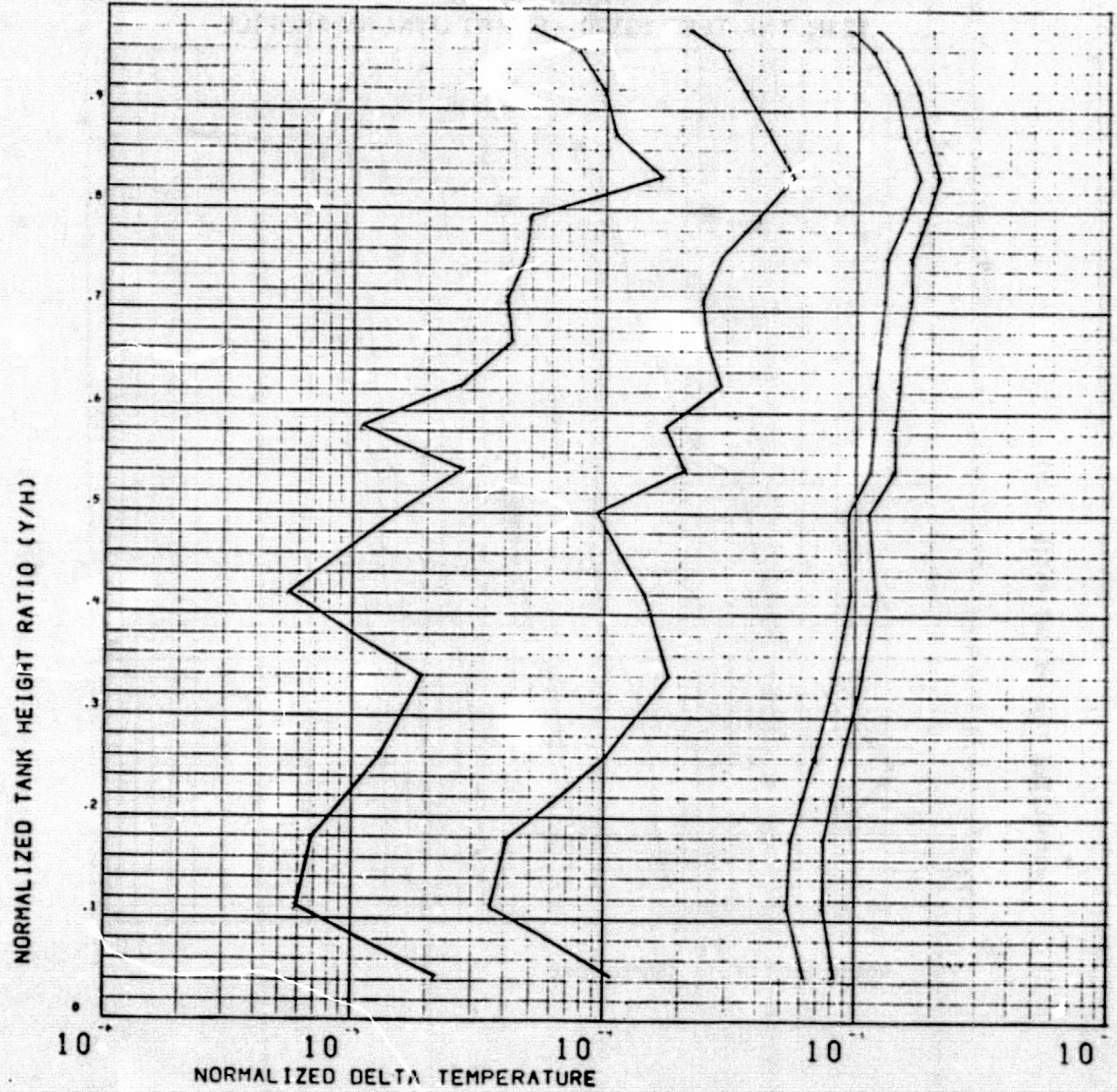


FIGURE 5.5-3d
12 IN. TNK TEST 1GΣ20 – STRAT DTNORM PROFILE

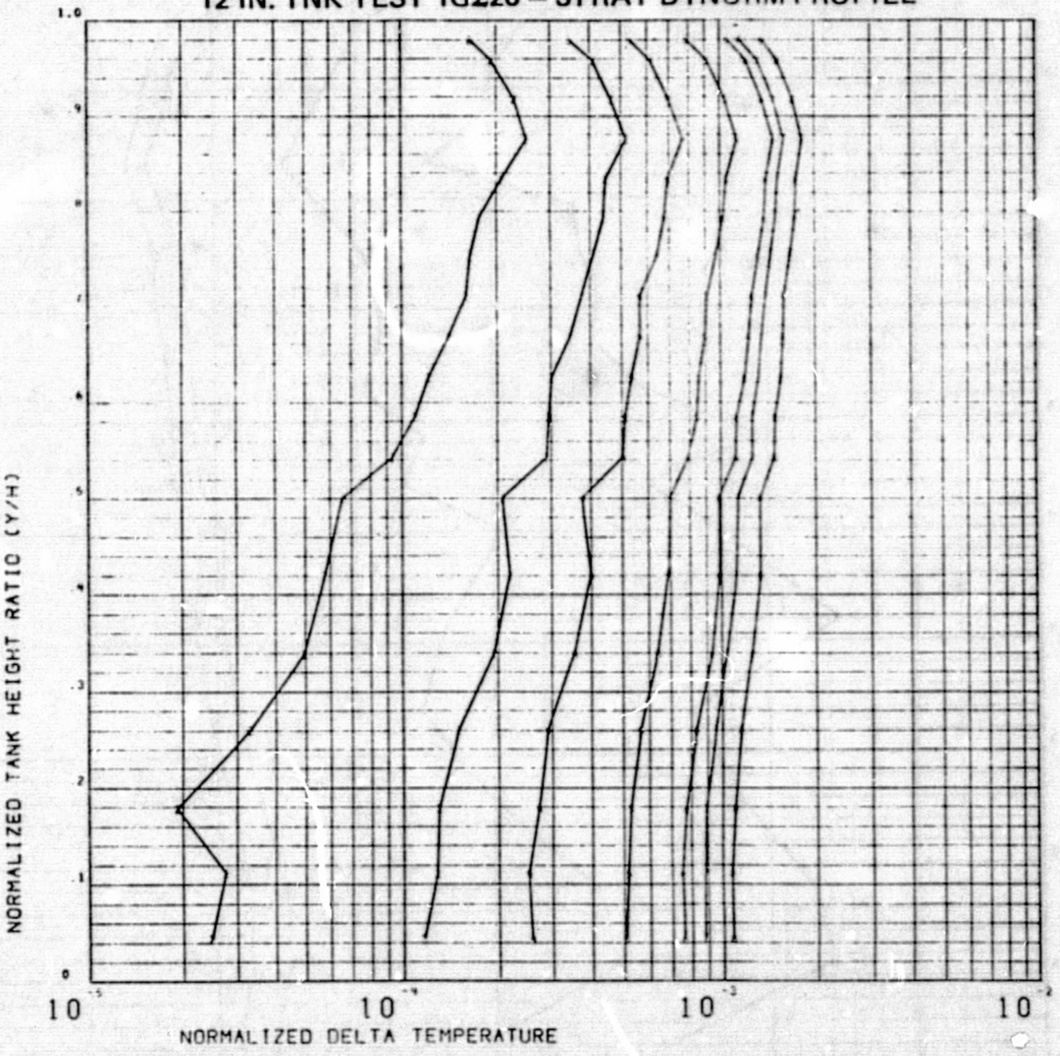


FIGURE 5.5-3e
12 IN. TNK TST1G22 STRAT DTNORM PROFILE

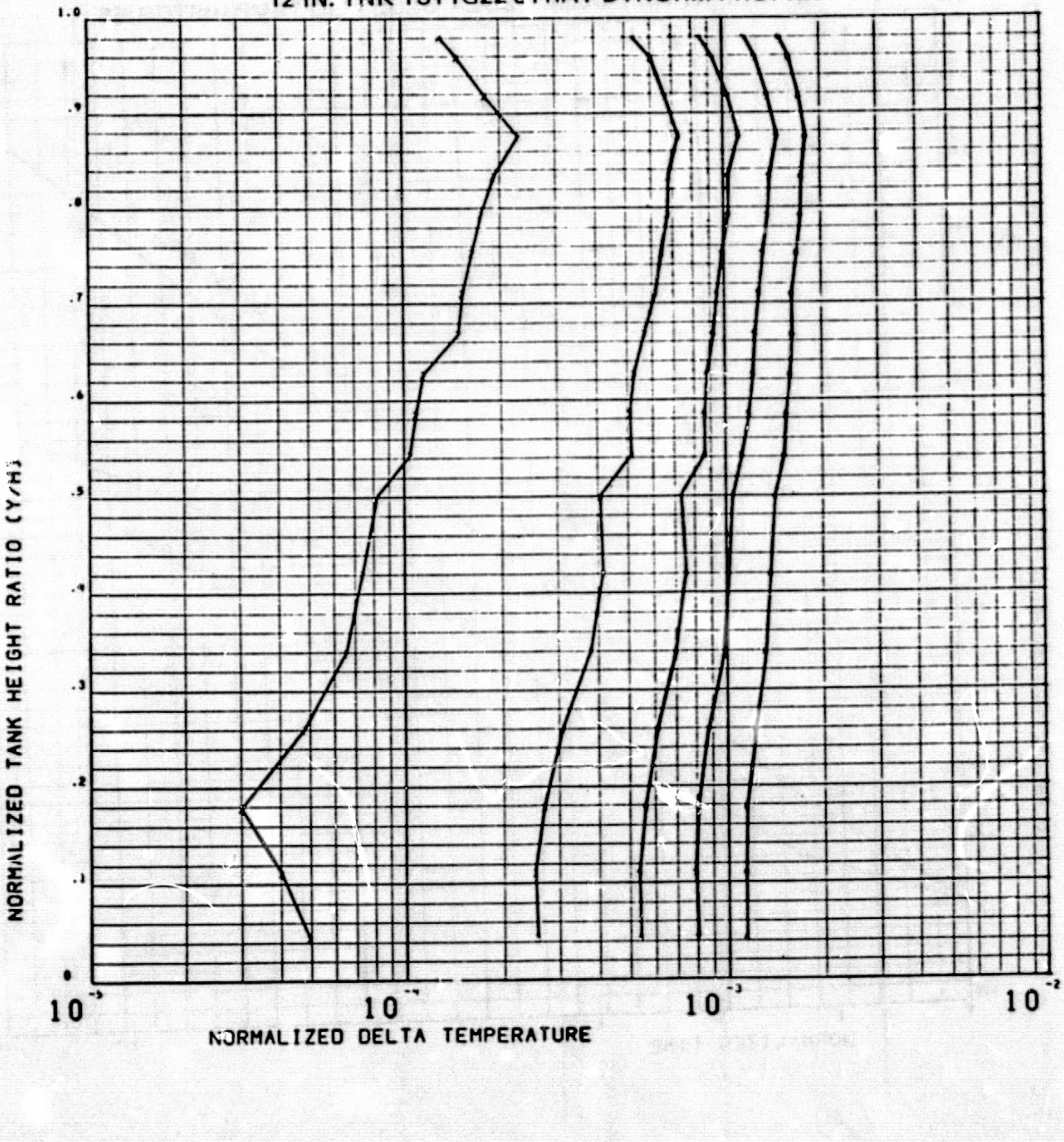


FIGURE 5.5-4a

6 IN. TNK TEST 8GΣ1 – BULK ULGE γ LIQ TEMP HISTORIES

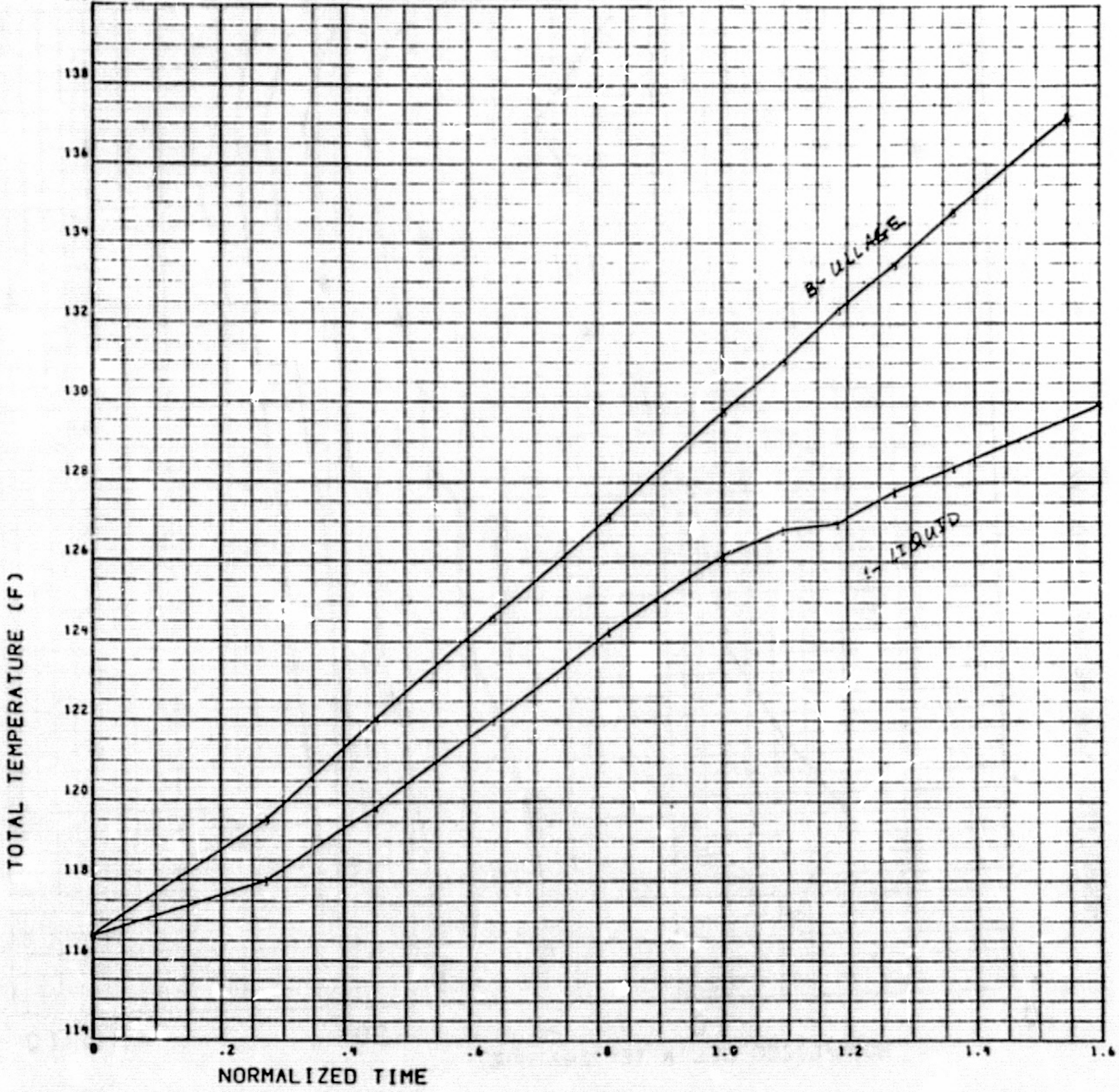


FIGURE 5.5-4b
6 IN. TNK TST8G5 BULK ULGEγLIQ TEMP HISTORIES

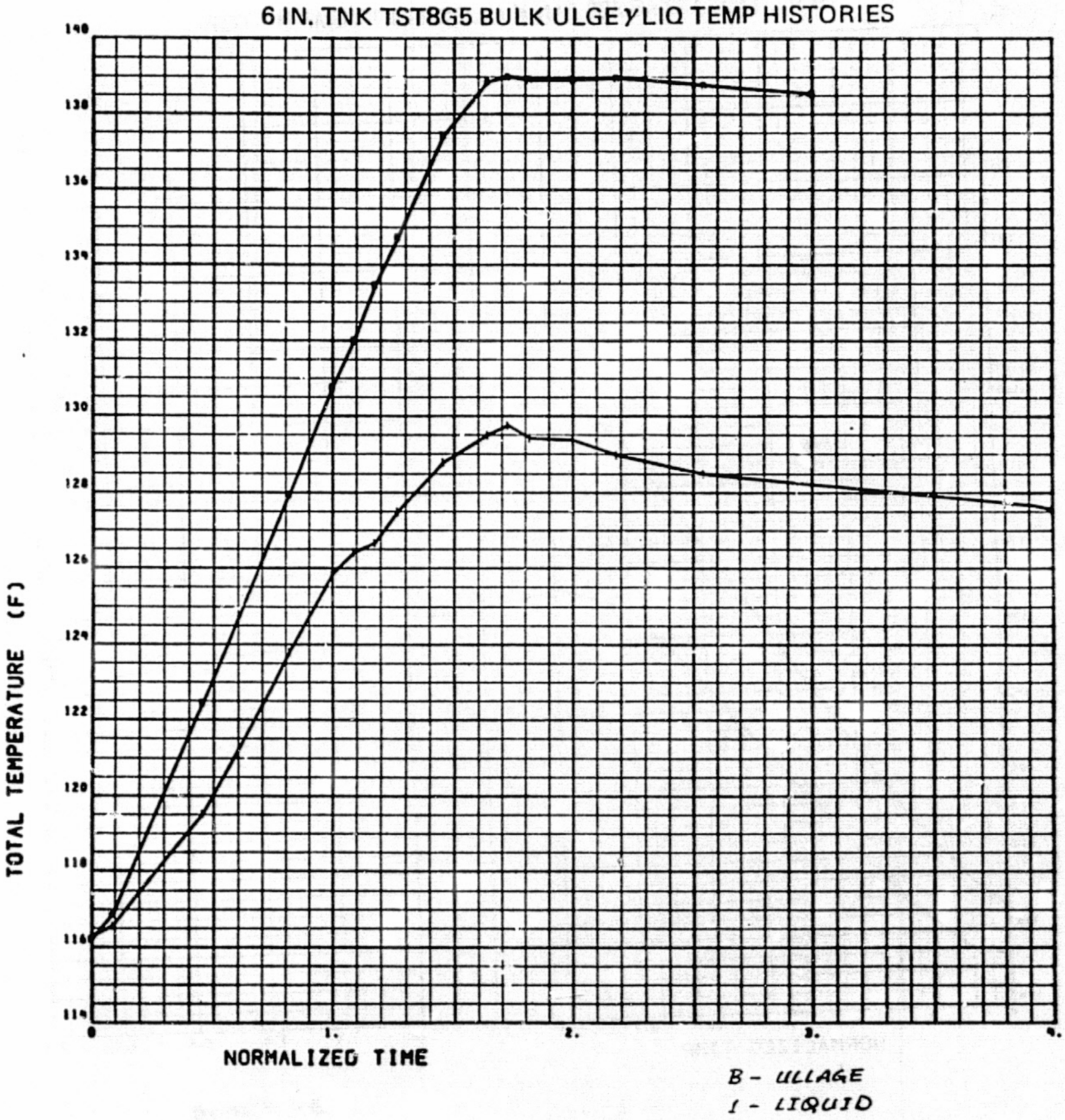
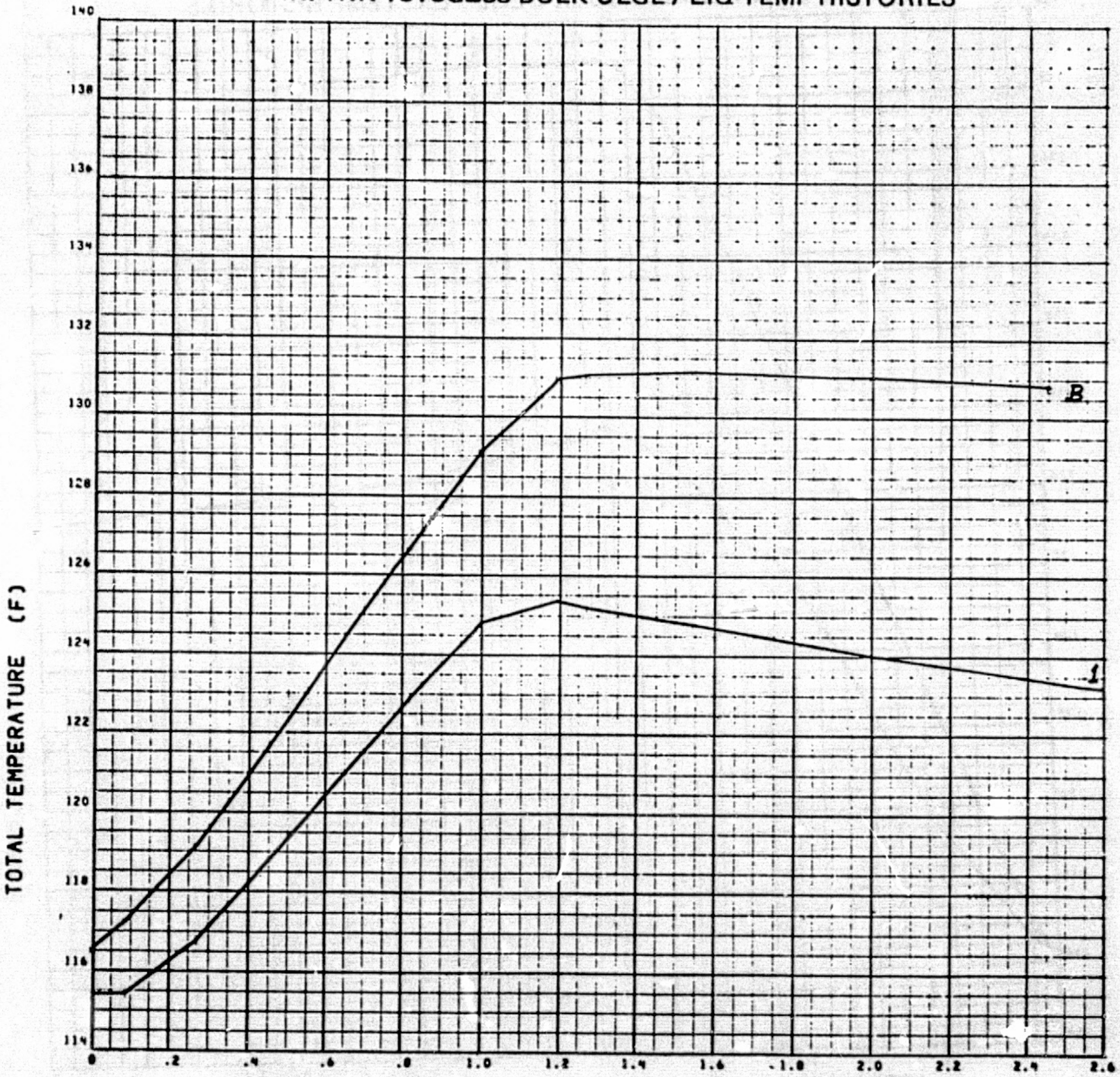


FIGURE 5.5-4c

6 IN. TNK TST8GΣBS BULK ULGE Y LIQ TEMP HISTORIES



B - ULLAGE
1 - LIQUID

FIGURE 5.5-4d
12 IN. TNK TEST 1GΣ20 – BULK ULGE/LIQ TEMP HISTORIES

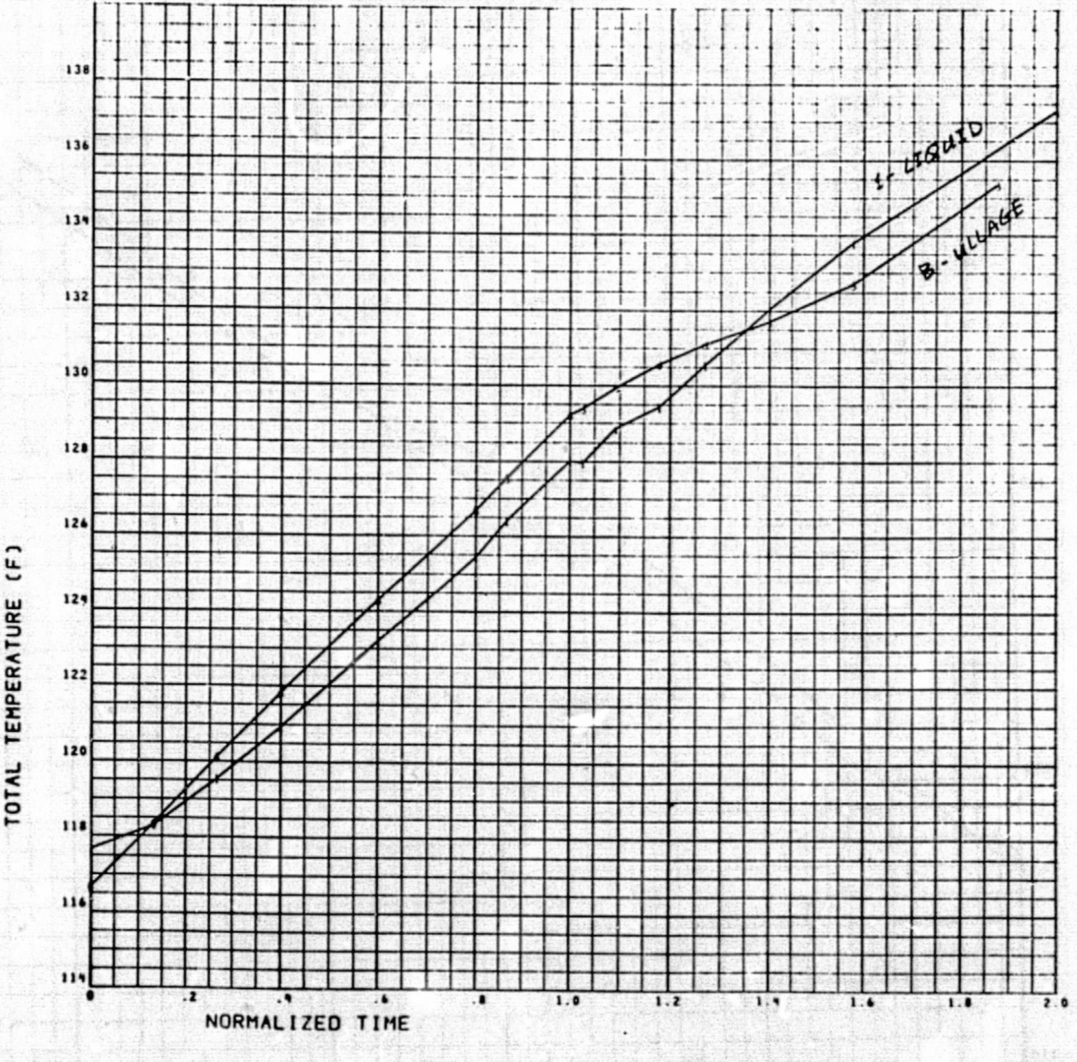


FIGURE 5.5-4e

12 IN. TNK TST1G22 BULK ULGEγ LIQ TEMP HISTORIES

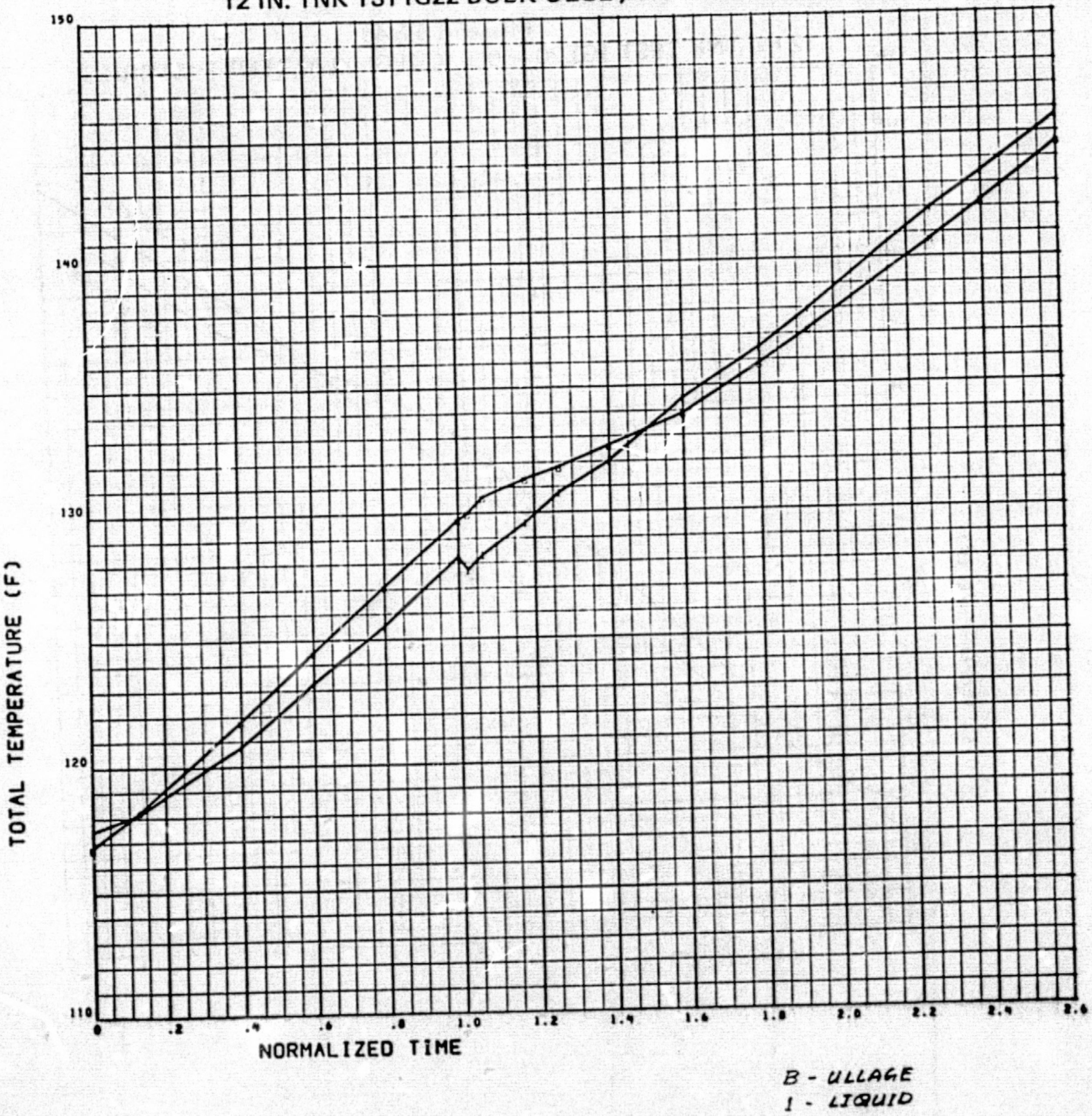
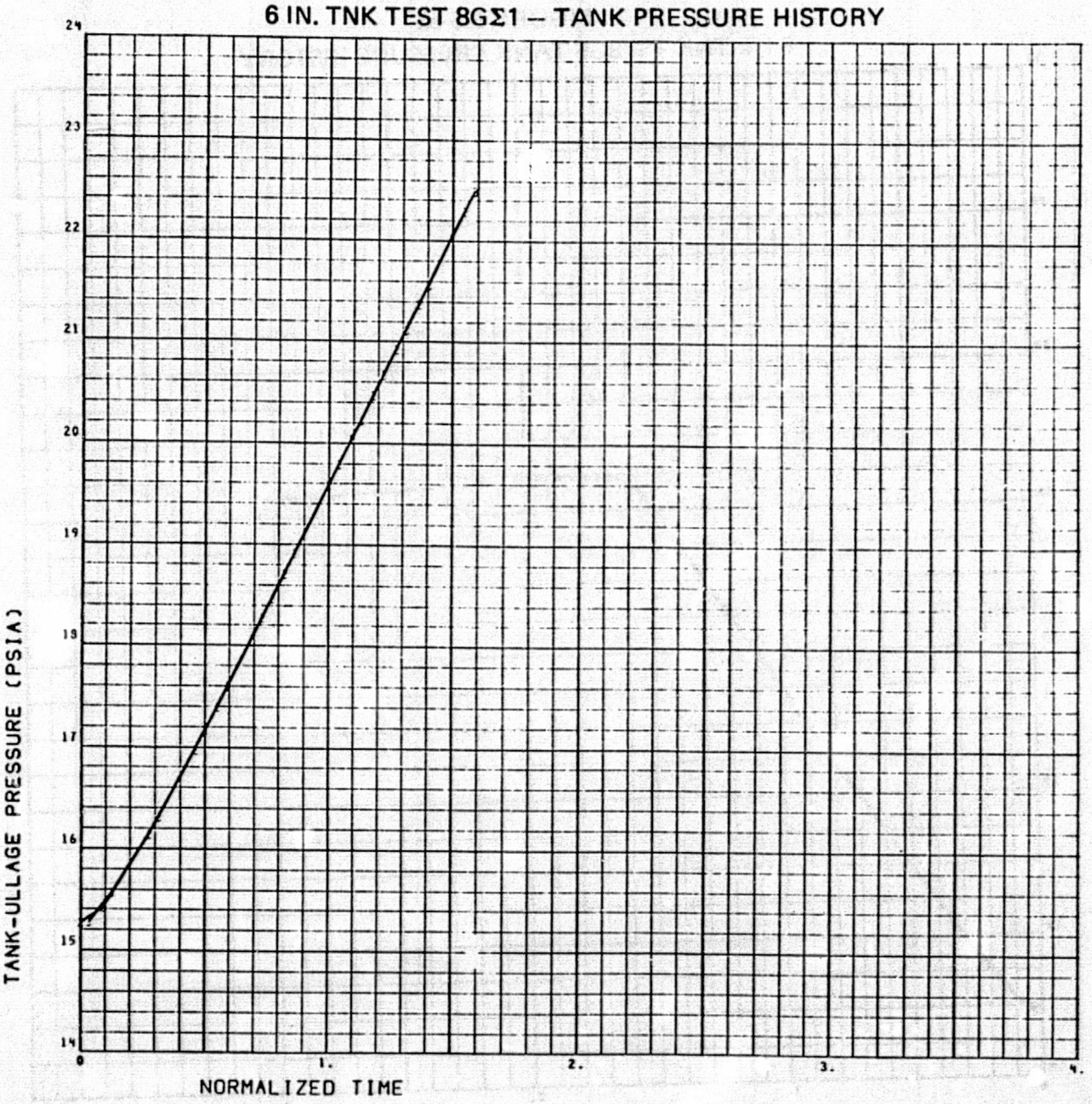
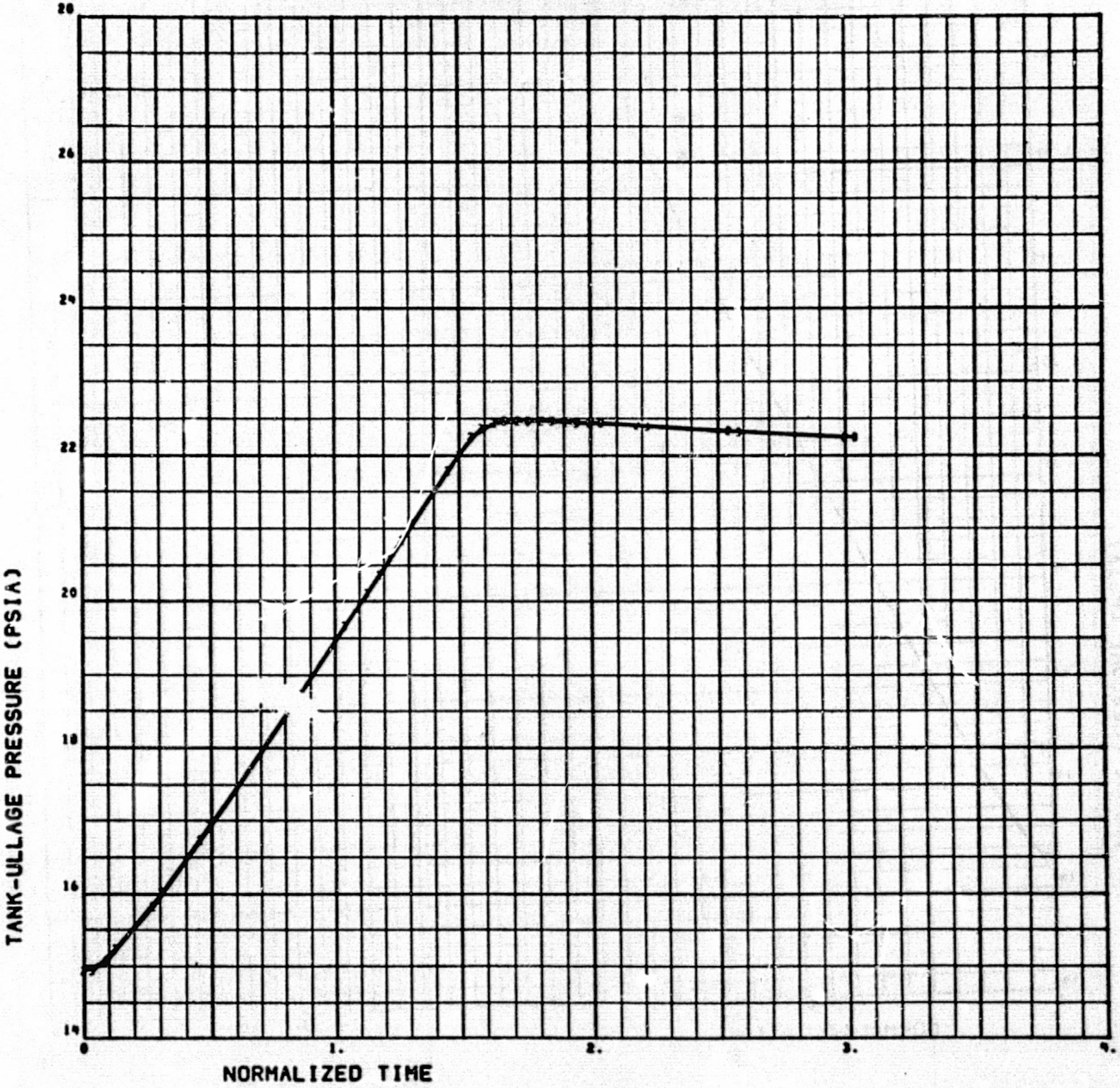


FIGURE 5.5-5a
6 IN. TNK TEST 8GΣ1 – TANK PRESSURE HISTORY



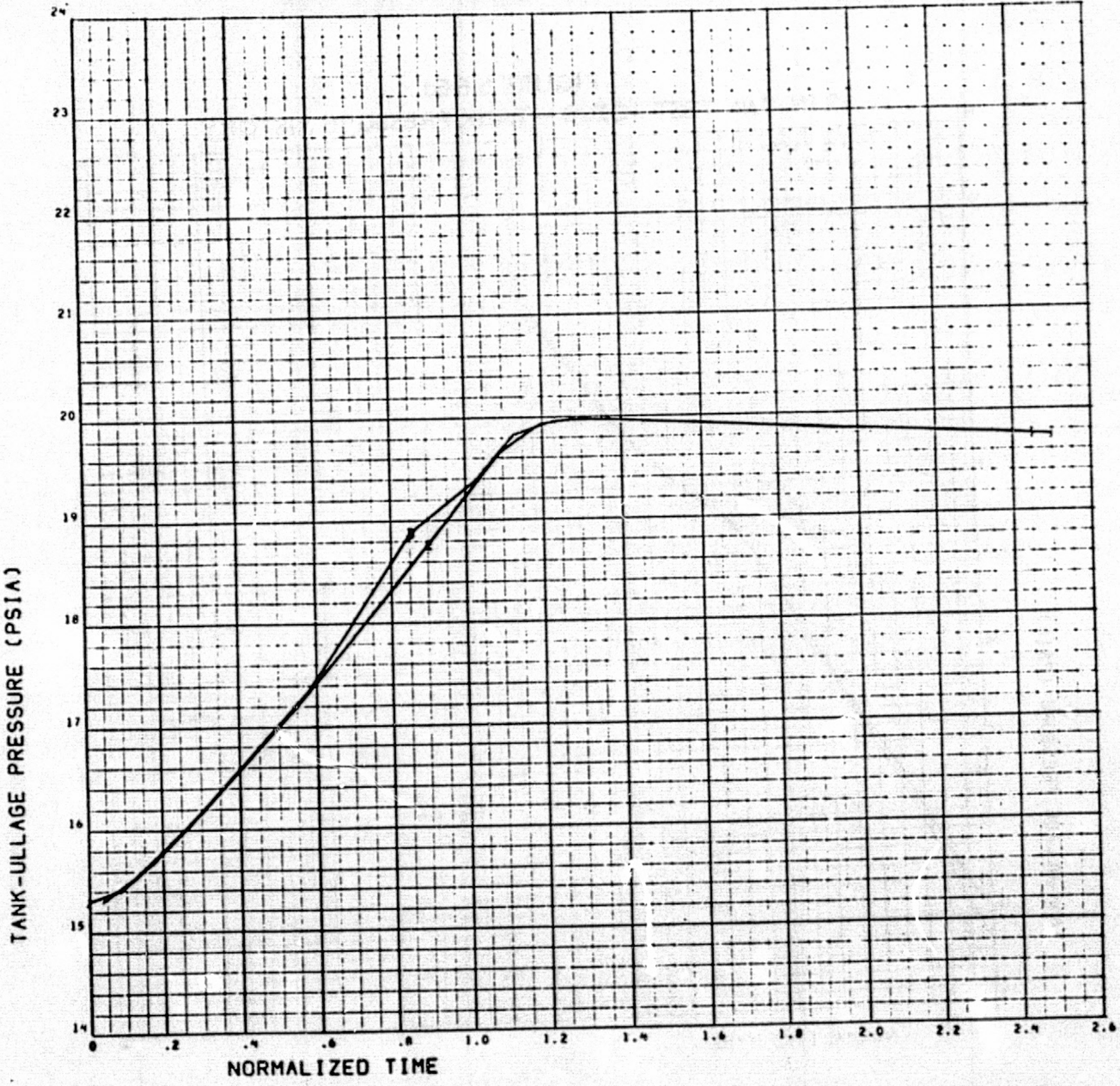
2
3 Transducer measured

FIGURE 5.5-5b
6 IN. TNK TST8G5 TANK PRESSURE HISTORY



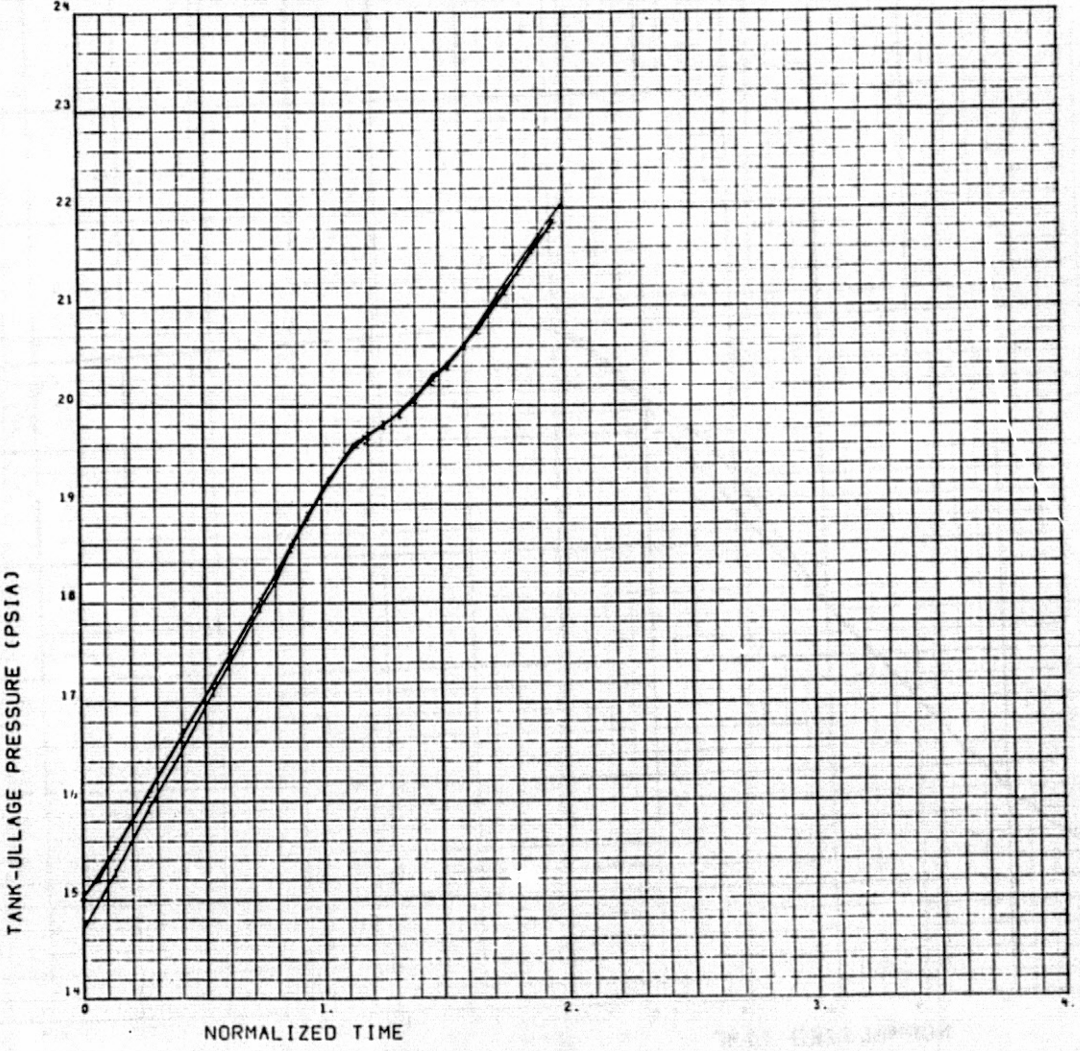
2, 3, Transducer Measured

FIGURE 5.5-5c
6 IN. TNK TST8GΣ8S TANK PRESSURE HISTORY



2, 3 Transducer Measured

FIGURE 5.5-5d
12 IN. TNK TEST 1GΣ20 – TANK PRESSURE HISTORY



1 - Gage measured

2 } - Transducer measured
3 }

FIGURE 5.5-5e
12 IN. TNK TST1G22 TANK PRESSURE HISTORY

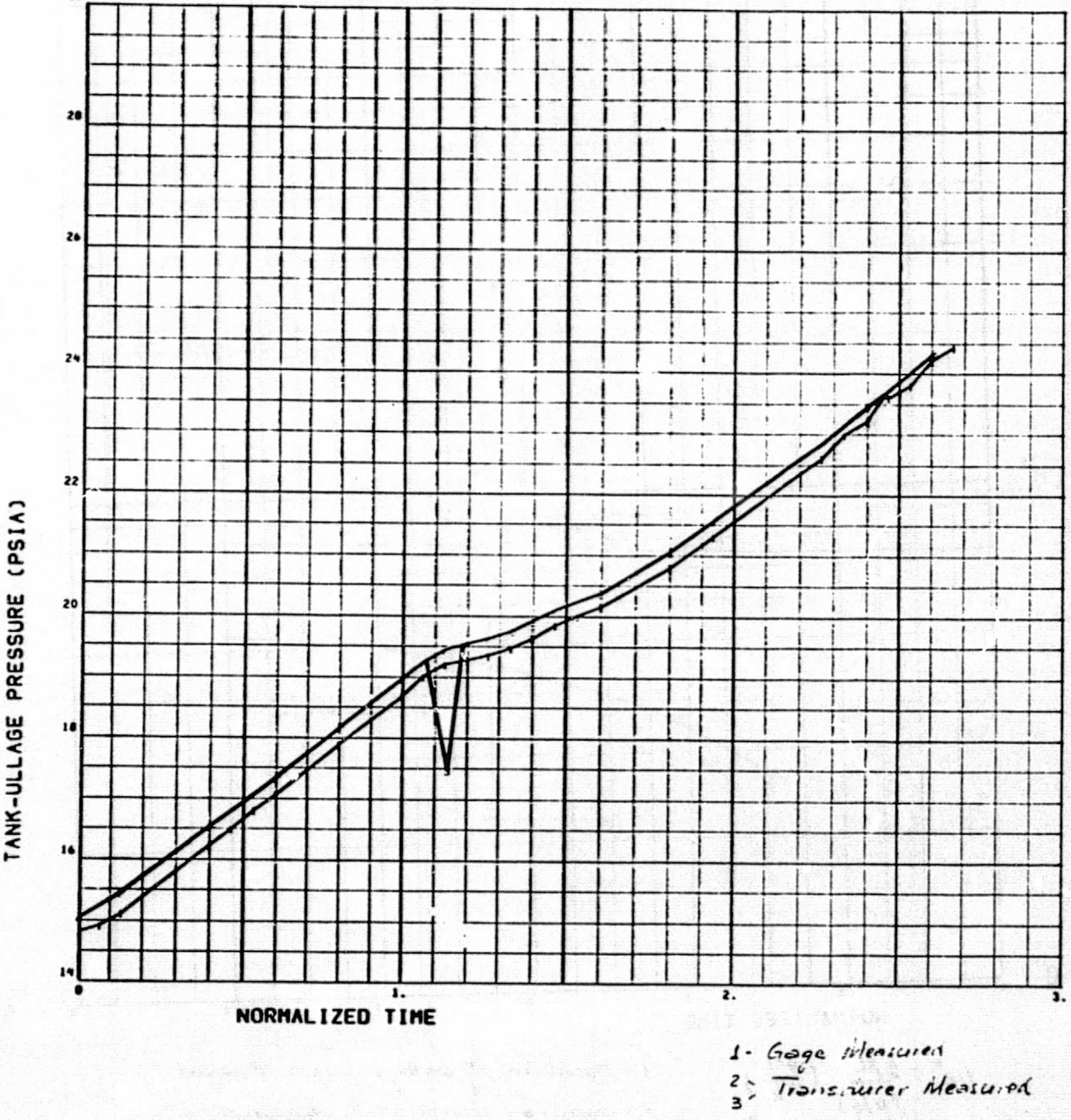
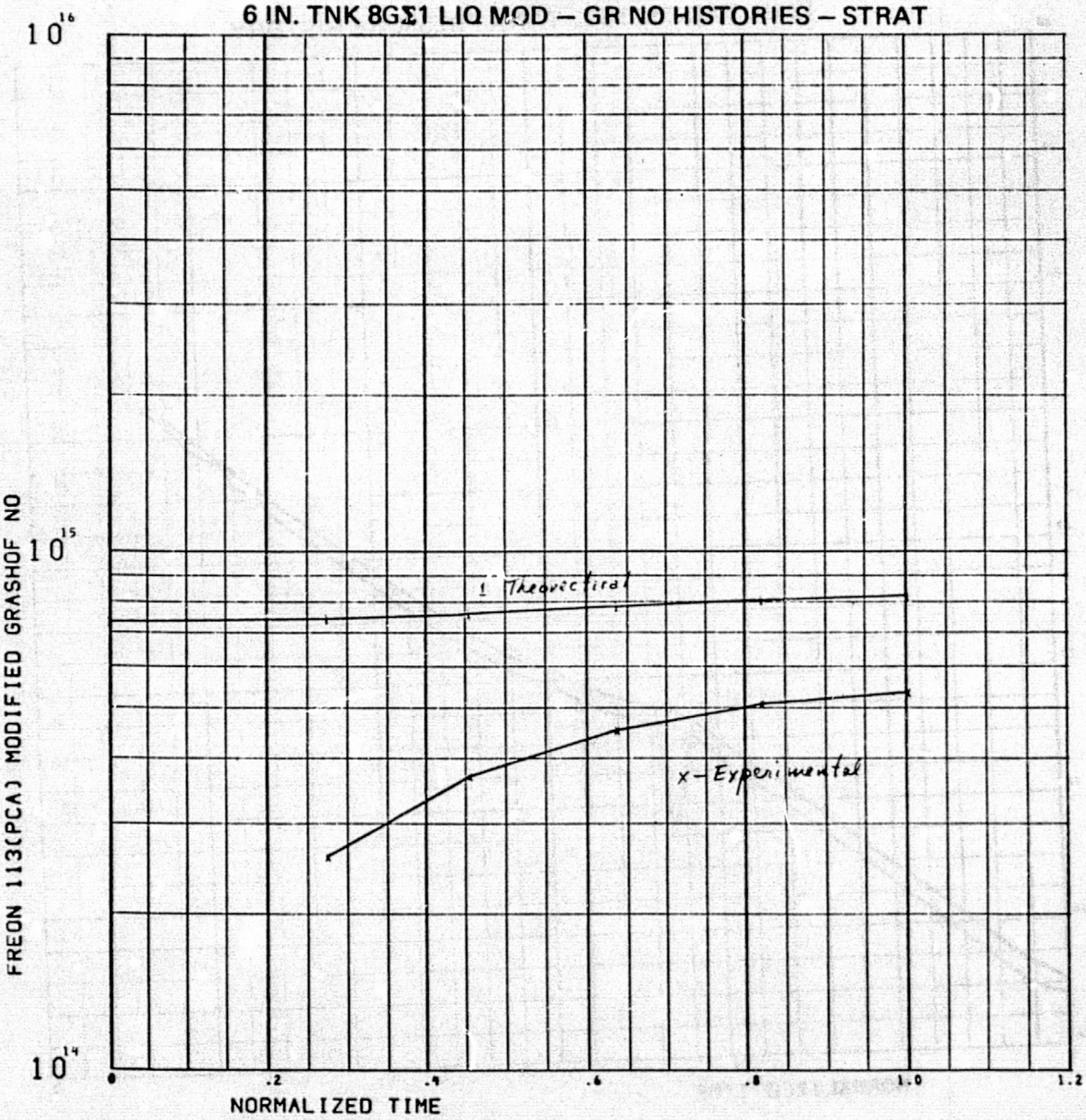


FIGURE 5.5-6a

6 IN. TNK 8GΣ1 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2}\left(\frac{q''L}{k}\right)$$

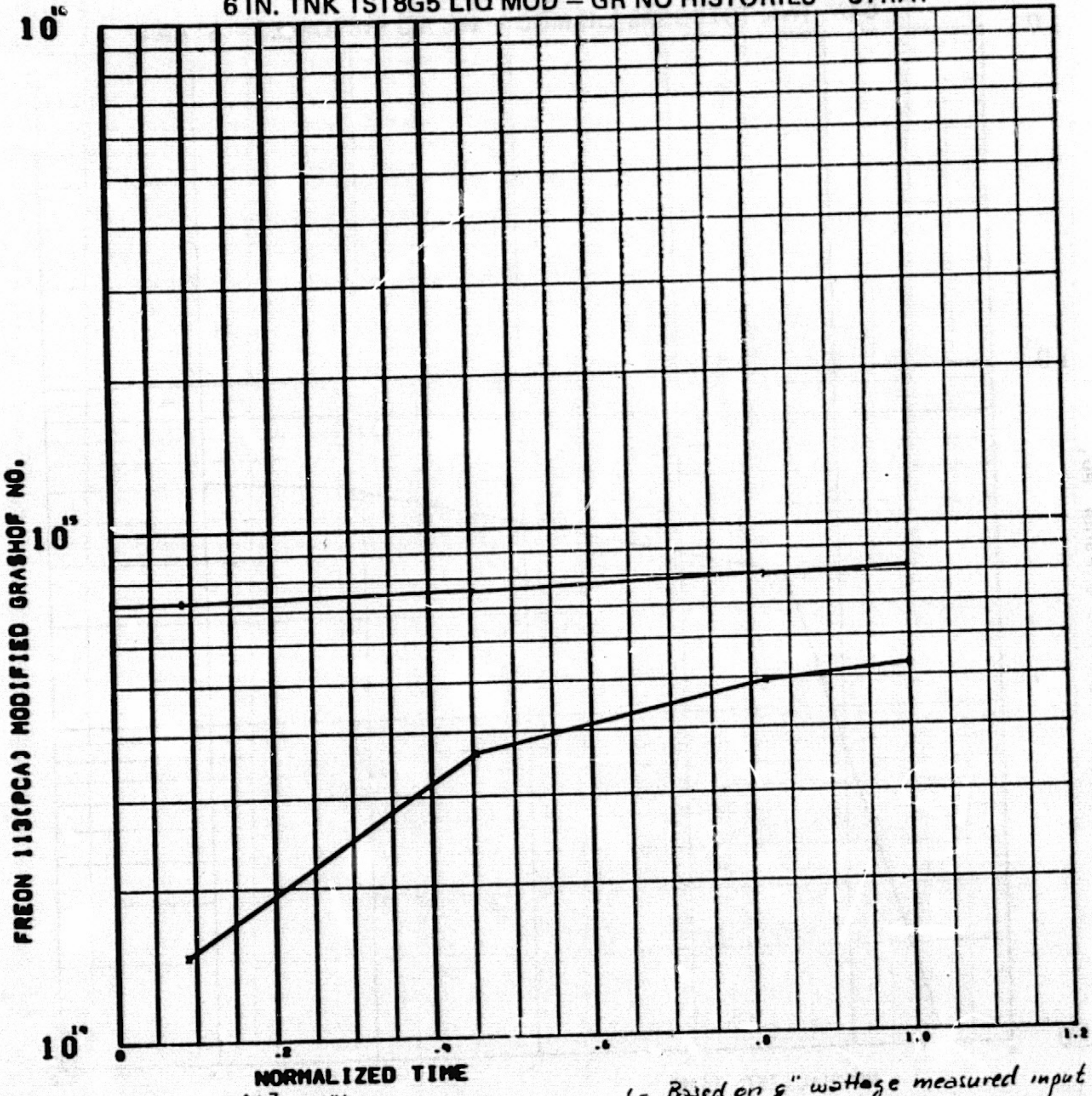
L = Liquid depth

1 = Based on q''_H wattage measured input

X = Based on experimentally determined $q''_{fluid(l)}$

FIGURE 5.5-6b

6 IN. TNK TST8G5 LIQ MOD – GR NO HISTORIES – STRAT



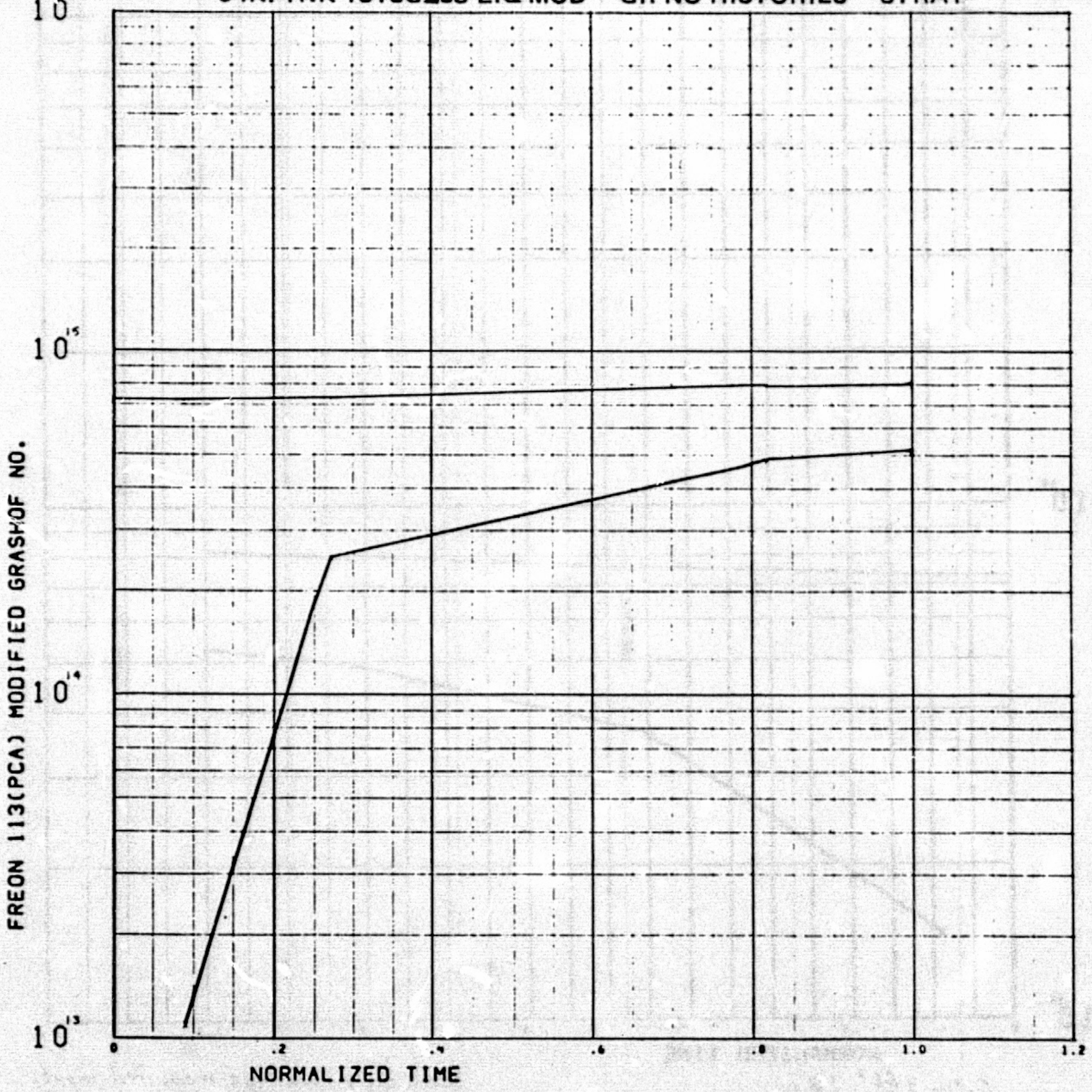
$Gr^* = \frac{g \beta L^3}{(\mu/\rho)^2_\ell} \left(\frac{q''_H L}{k} \right)$

L = Fluid depth

! - Based on q''_H wattage measured input

x - Based on experimentally absorbed q''_{fluid}

FIGURE 5.5-6c
6 IN. TNK TST8GΣ8S LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''_H L}{k}\right)$$

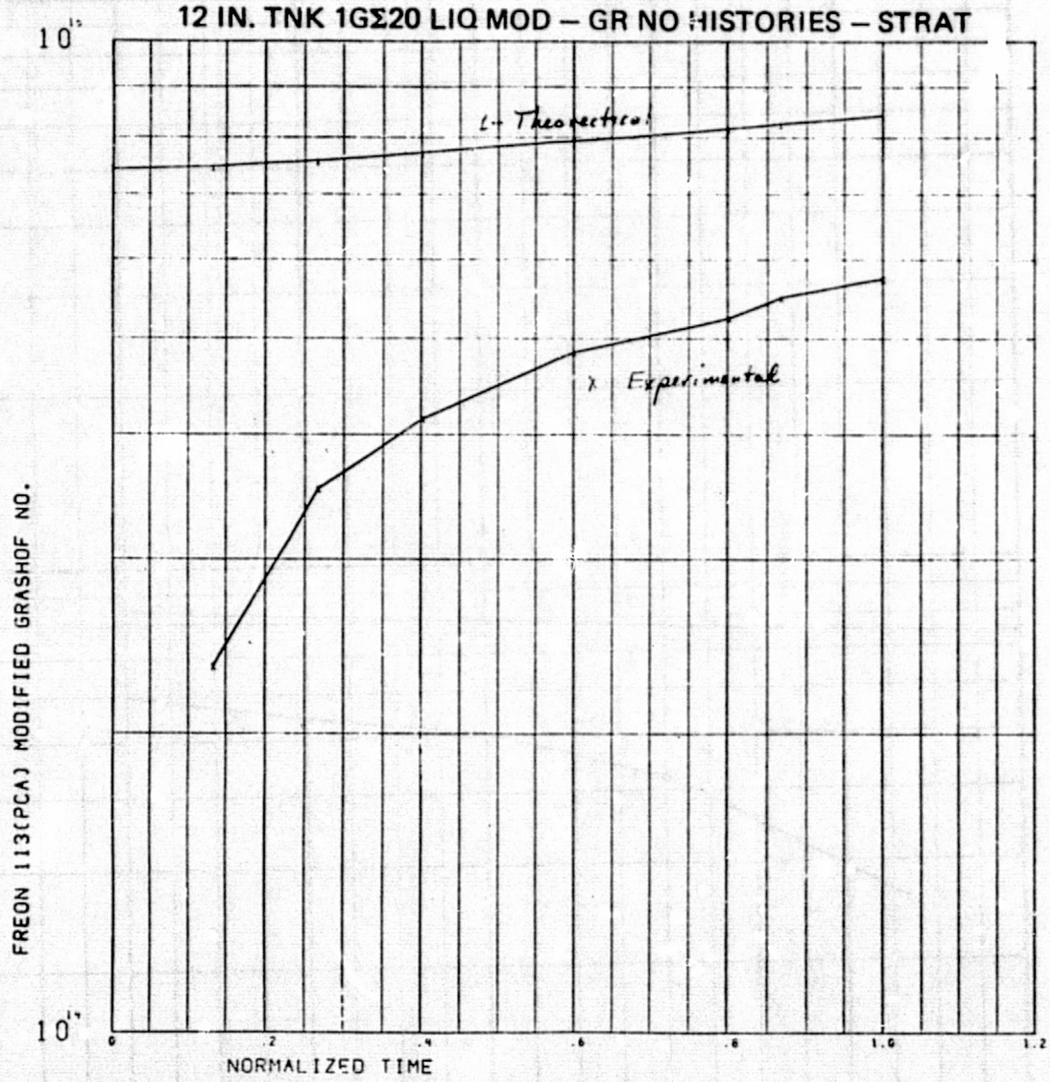
L = Fluid depth

1 - Based on q''_H wattage measured input

x - Based on experimentally absorbed $q''_{fluid(\ell)}$

FIGURE 5.5-6d

12 IN. TNK 1GΣ20 LIQ MOD – GR NO HISTORIES – STRAT



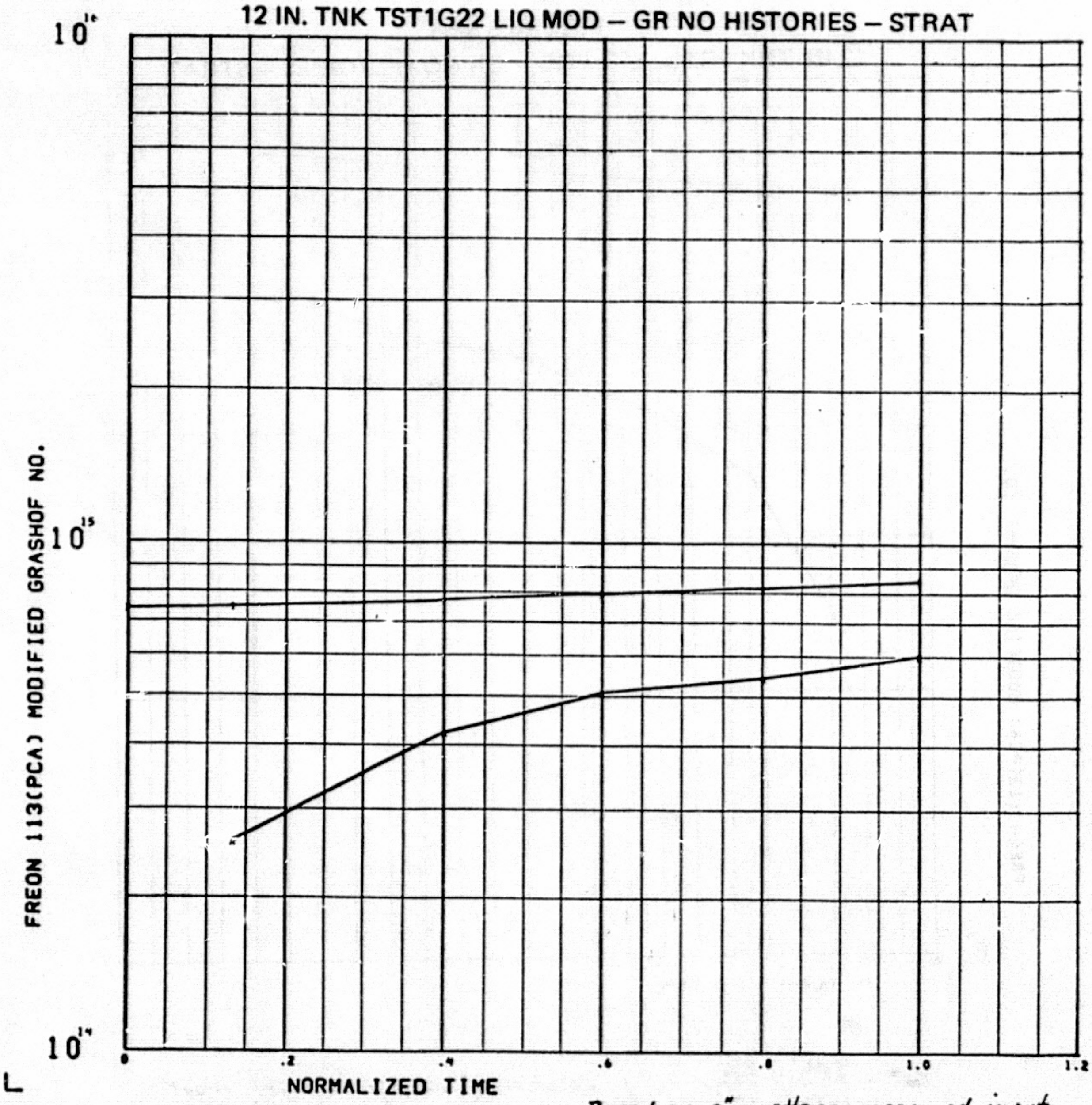
$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2}\left(\frac{q''L}{k}\right)$

L = Fluid depth

1 = Based on $\frac{q''}{D_H}$ wattage measured input

X = Based on experimentally determined $q''_{fluid(l)}$

FIGURE 5.5-6e
12 IN. TNK TST1G22 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$

L = Fluid depth

1 = Based on q''_H wattage measured input
x = Based on experimentally absorbed $q''_{fluid(\ell)}$

FIGURE 5.5-7a
6 IN. TNK 8GΣ1 LIQ FOURIER NO HISTORY

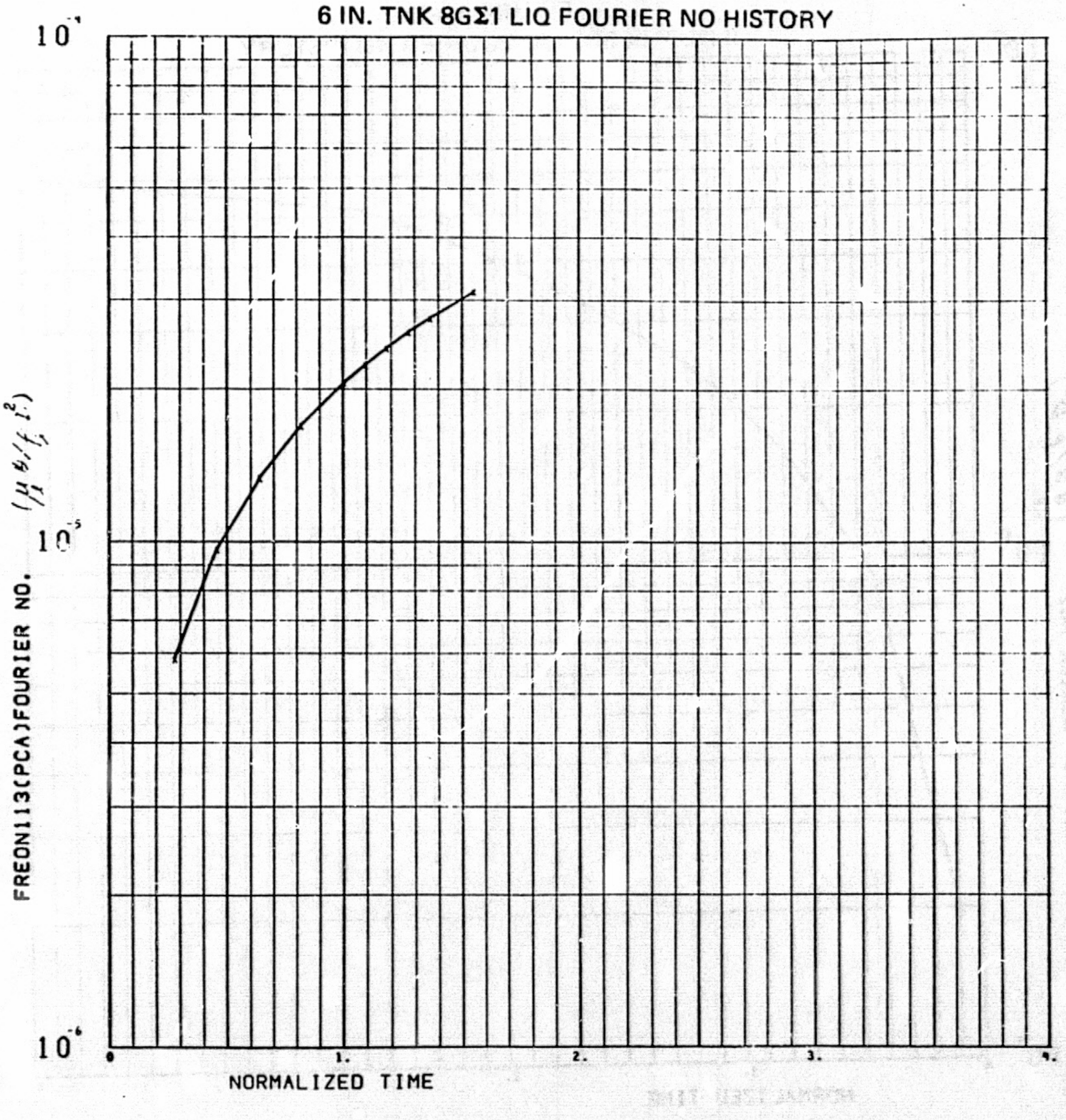


FIGURE 5.5-7b
6 IN. TNK 8G5 LIQ FOURIER NO HISTORY

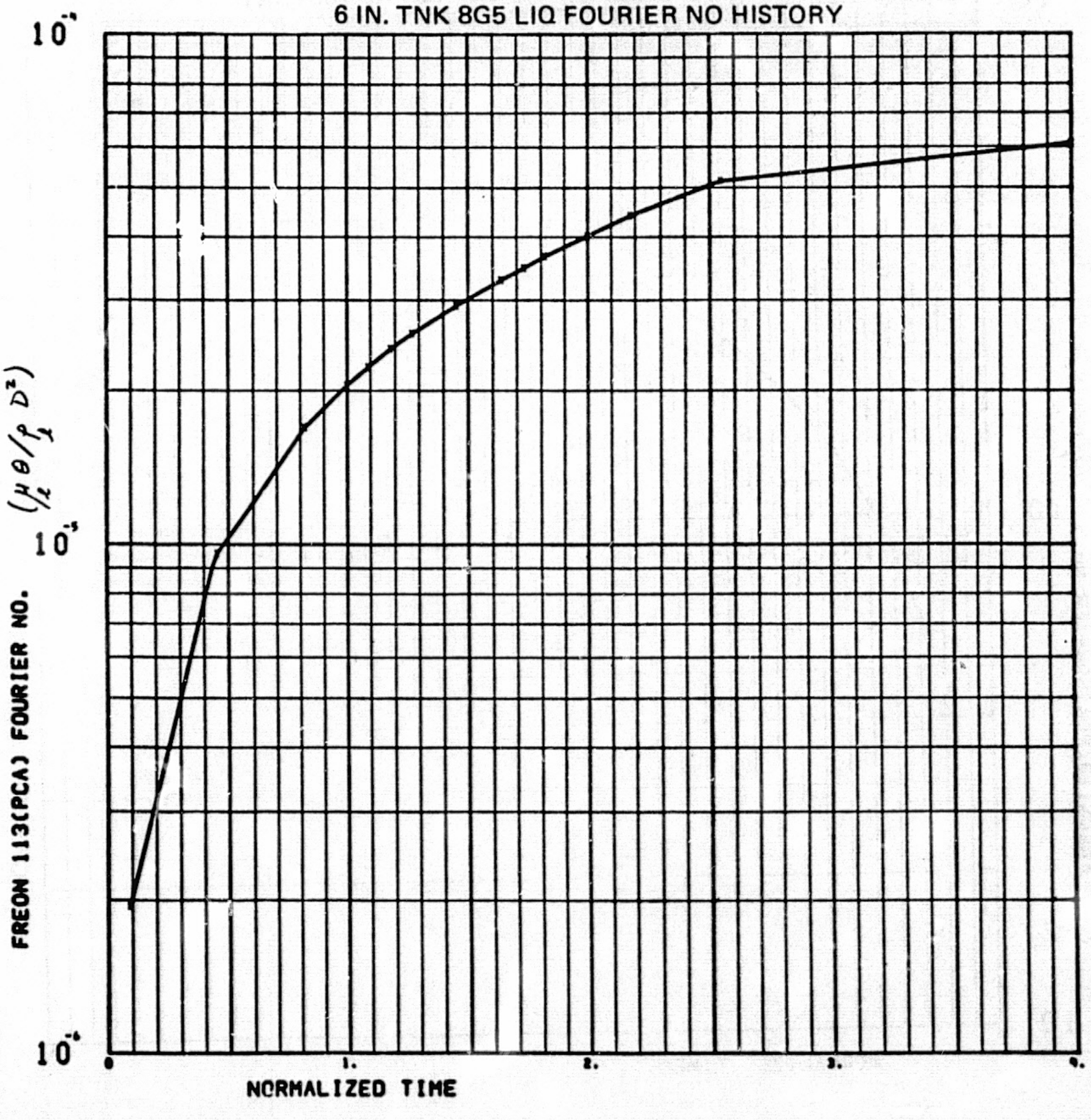


FIGURE 5.5-7c

6 IN. TNK 8GΣ8S LIQ FOURIER NO HISTORY

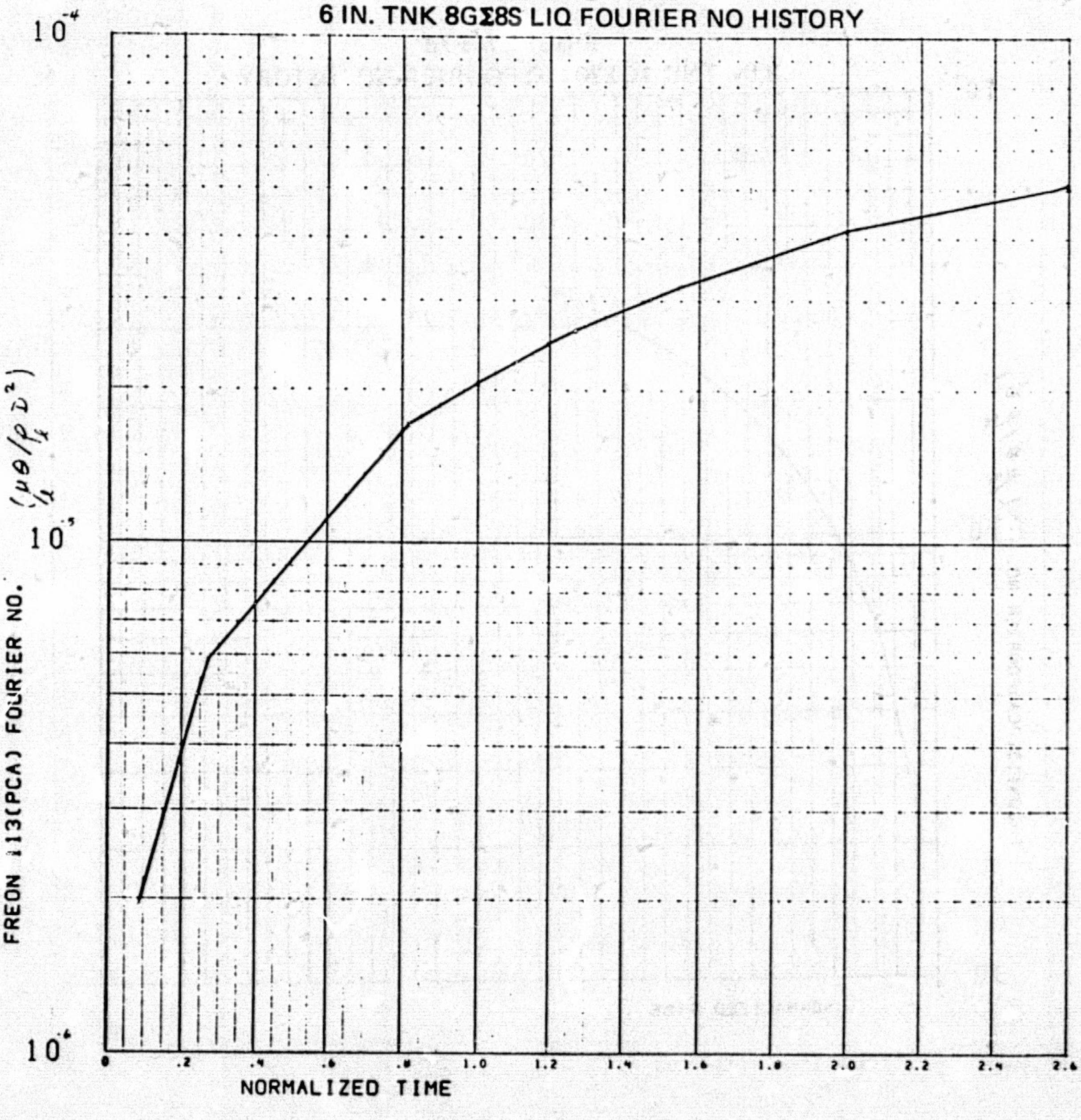


FIGURE 5.5-7d
12 IN. TNK 1GΣ20 LIQ FOURIER NO HISTORY

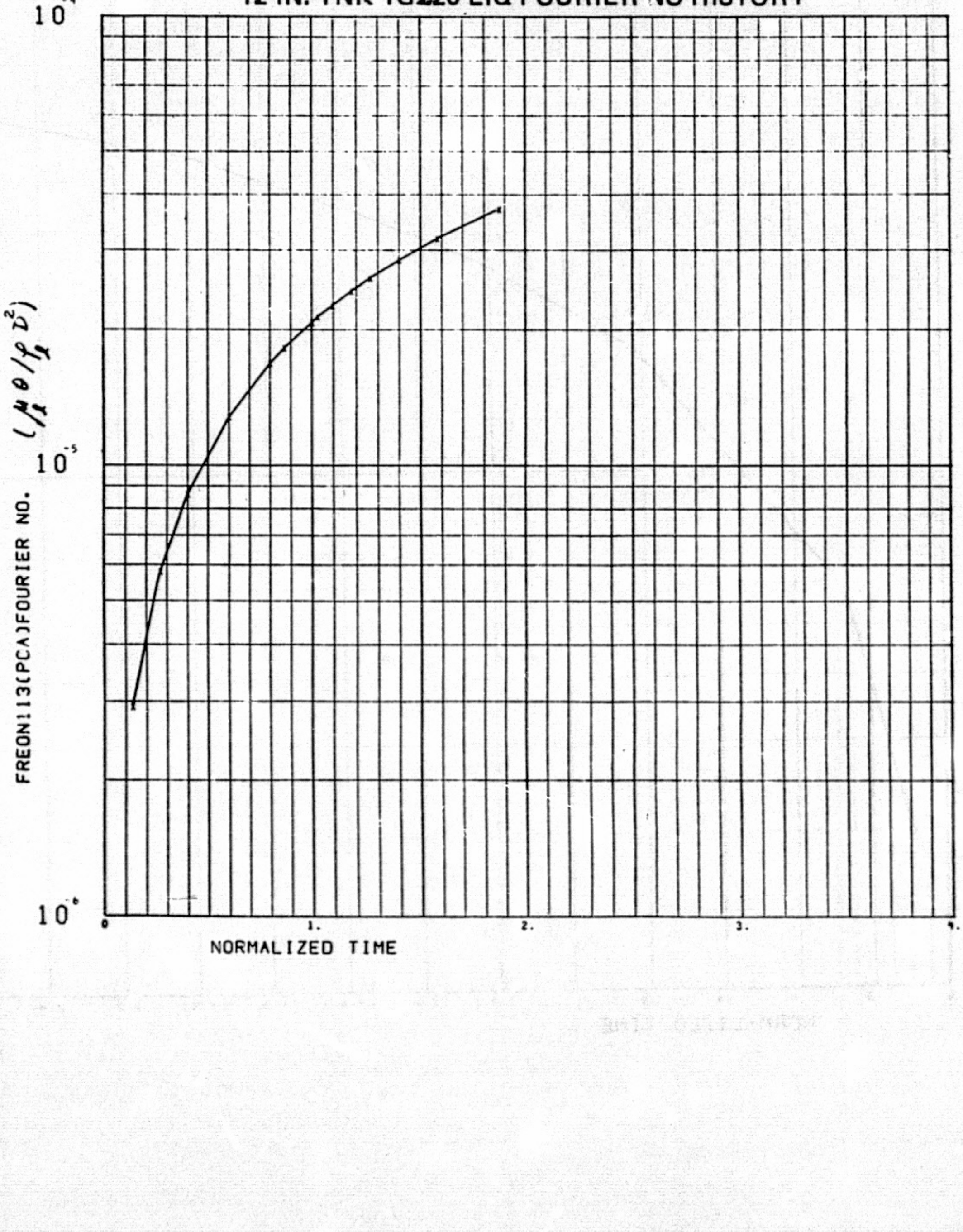
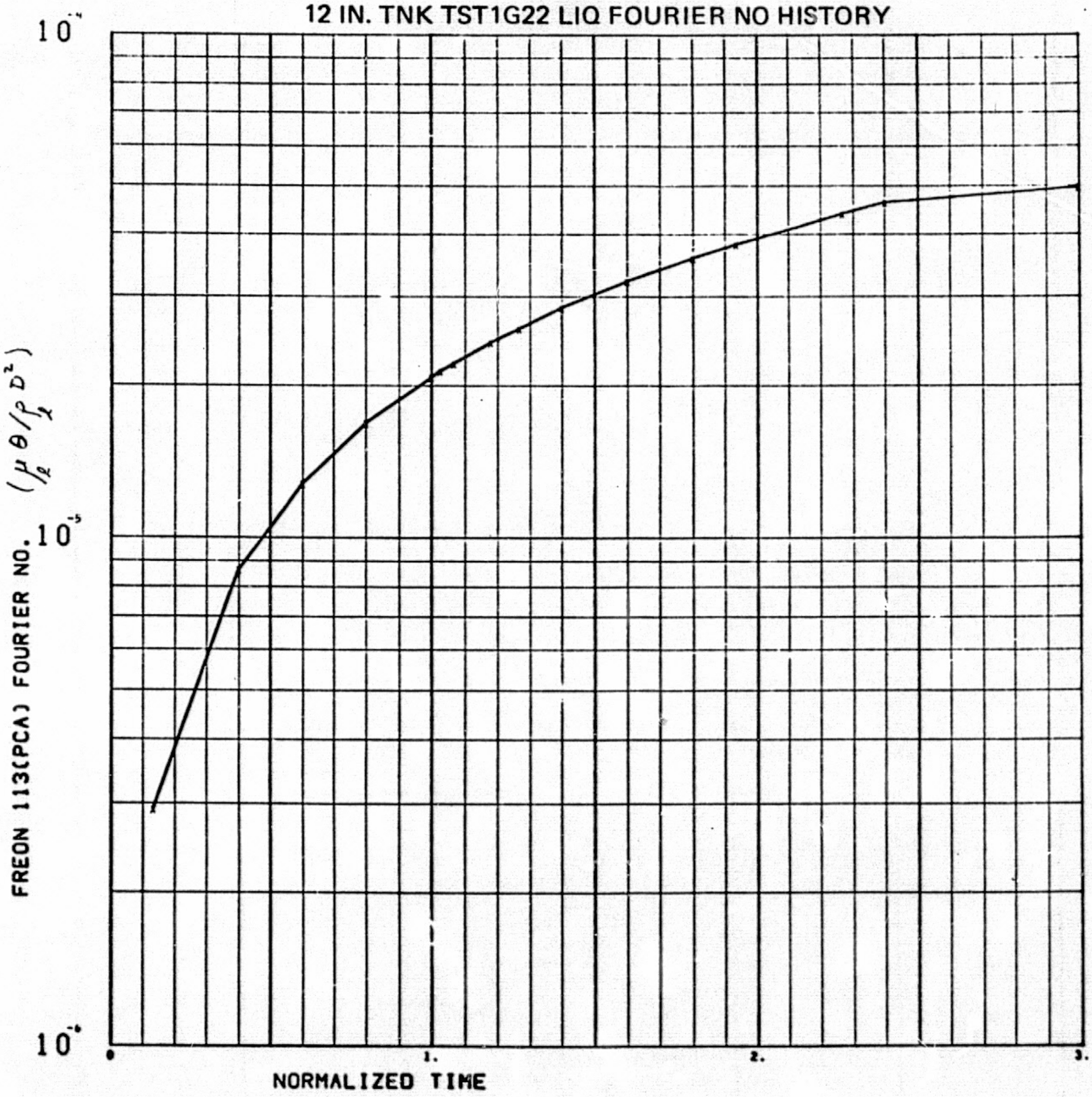


FIGURE 5.5-7e

12 IN. TNK TST1G22 LIQ FOURIER NO HISTORY



Section 5.6

SCALING SET

6-in.-Dia Tank Tests	12-in.-Dia Tank Tests
8G	1G
Test #4 Test #6	Test #23 Test #28

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Table 5. 6-1a. 6 IN. DIA. TANK TEST 8G#4 (Page 1 of 3)

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STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

DOME AREA FT2=   .3927      CYL AREA FT2= 1.5708       FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131     1/2 CYL WALL VOLFT3=   .00164     FLNGE VOL FT3=     .00076
DME MASS LBM=   ,65596     MASS 1/2 CYL LBM=    ,81996     FLANGE MASS=   ,38058

LIQ VOL FT3=   ,22907      ULLAGE VOL FT3=   ,03272

INPUT HEAT FLUXES (BTU/HR=FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 600,8488   H34= 600,8488   H56= 600,8488   H910= 600,8488   H78= 600,8488

EST,HT FLUX IN LIQ (BTU/HR=FT2)= 600.8488
EST,HT FLUX IN ULLGE (BTU/HR=FT2)= 600.8488
EST,HT INPUT LIQ(STRAT)BTU=    73.735       (STRAT+DESTRAT)BTU=  111,429
EST,LIQ TEMP INCRSE(STRAT)=   15.1319F      (STRAT+DESTRAT)=   22.8570F

EST,HT INPUT ULLAGE(STRAT)BTU=    14.747      (STRAT+DESTRAT)BTU=   22,286
```

Table 5. 6-1b. 6 IN. DIA. TANK TEST 8G#6

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

DOME AREA FT2=   .3927      CYL AREA FT2= 1.5708       FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131     1/2 CYL WALL VOLFT3=   .00164     FLNGE VOL FT3=     .00076
DME MASS LBM=   .65596     MASS 1/2 CYL LBM=    .81996     FLANGE MASS=   .38058

LIQ VOL FT3=   .22907      ULLAGE VOL FT3=   .03272

INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 600.8488   H34= 600.8488   H56= 600.8488   H910= 600.8488   H78= 600.8488

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 600.8488
EST.HT FLUX IN ULLGE (BTU/HR-FT2)= 600.8488
EST.HT INPUT LIQ(STRAT)BTU=    74.718       (STRAT+DESTRAT)BTU=  262.169
EST.LIQ TEMP INCRSE(STRAT)=   15.3317F      (STRAT+DESTRAT)=   53.7555F

EST.HT INPUT ULLAGE(STRAT)BTU=    14.944      (STRAT+DESTRAT)BTU=   52.434
```

Table 5.6-1c. 12 IN. DIA. TANK TEST 1G#23 (Page 2 of 3)

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS
 ------------------------------------------------------------------------------------
  DOME AREA FT2=  1,5708        CYL AREA FT2=  6,2832       FLNGE AREA FT2=    ,1458
 DME WALL VOL FT3=    ,01047      1/2 CYL WALL VOLFT3=    ,01309     FLNGE VOL FT3=    ,00608
 DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965      FLANGE MASS=  3,04465
 ------------------------------------------------------------------------------------
  LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=    ,26180
 ------------------------------------------------------------------------------------
  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12= 300,4244   H34= 300,4244   H56= 299,5561   H910= 300,4244   H78= 300,4244
 ------------------------------------------------------------------------------------
 EST,HT FLUX IN LIQ (BTU/HR-FT2)= 300.0771
 EST,HT FLUX IN ULLGE (BTU/HR-FT2)= 300,4244
 ------------------------------------------------------------------------------------
 EST,HT INPUT LIQ(STRAT)BTU=  589,200      (STRAT+DESTRAT)BTU= 1086,485
 EST,LIQ TEMP INCRSE(STRAT)=    15,1090F      (STRAT+DESTRAT)=   27,8279F
 ------------------------------------------------------------------------------------
 EST,HT INPUT ULLAGE(STRAT)BTU=  117,976      (STRAT+DESTRAT)BTU=  217.548
```

Table 5.6-1d. 12 IN. DIA. TANK TEST 1G#28 (Page 3 of 3)

```
           STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

  DOME AREA FT2=  1.5708       CYL AREA FT2=  6.2832       FLNGE AREA FT2=    .1458
 DME WALL VOL FT3=    .01047       1/2 CYL WALL VOLFT3=    .01309      FLNGE VOL FT3=    .00608
 DME MASS LBM=  5.24772       MASS 1/2 CYL LBM=  6.55965      FLANGE MASS=  3.04465

  LIQ VOL FT3=  1.83260        ULLAGE VOL FT3=    .26180

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12= 300.4244    H34= 300.4244    H56= 299.5561    H910= 300.4244    H78= 300.4244

 EST.HT FLUX IN LIQ (BTU/HR-FT2)= 300.0771
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)= 300.4244
 EST.HT INPUT LIQ(STRAT)BTU=  589.200      (STRAT+DESTRAT)BTU= 1139.120
 EST.LIQ TEMP INCRSE(STRAT)=    15.1106F       (STRAT+DESTRAT)=   29.1734F

 EST.HT INPUT ULLAGE(STRAT)BTU=  117.976     (STRAT+DESTRAT)BTU=  228.088
```

Table 5.6-2a. 6 IN. DIA TANK TEST 8G #4 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	1,000	1,667	2,330	3,000	3,750
TAU	C.000	,267	.445	.621	.800	1,000
1	116,333	122,750	126.792	130,375	134,083	137.958
2	116,875	125,708	129.563	132.833	136.167	139.479
3	117,417	128,667	132,333	135.292	138,250	141.000
4	117,625	128,125	131,792	134,458	136,875	139.625
5	117,083	126,042	129,500	131.708	134,250	136.667
6	116,958	125,833	129.083	131.333	133.500	135.625
7	117,250	126,583	128.958	131.208	133,083	135.167
8	117,250	126,042	127.625	130.000	132,167	133.792
9	115,333	119,458	120.833	122.333	124,125	125.792
10	117,000	128,750	132.667	135,833	139,083	142.458
11	117.167	129,292	132.292	135,167	137,833	140.583
12	117,583	129,750	131.708	134,083	136,458	138.667
13	116,833	128,167	129,583	130.958	132,625	134.375
14	116,333	122,750	126.792	130,375	134,083	137,958
15	116,500	126,333	129,708	132.917	136,417	139.583
16	116,792	126,667	129,667	132,125	135,042	137.708
17	116,583	123,542	126,583	128.500	130,958	133,083
18	115,958	123,333	125,375	127.708	129,458	131.000
19	115,542	118,917	120.542	122.417	124.125	125.917
20	117,000	128,750	132.667	135,833	139,083	142.458
21	117,167	129,292	132,292	135.167	137,833	140,583
22	117,583	129,750	131.708	134,083	136,458	138.667
23	116,833	128,167	129,583	130,958	132,625	134.375
24	116,417	149,958	169,708	186,250	200,583	213.333
25	116,125	123,167	127,917	135,500	147,625	157.958
26	116,167	122,250	126,417	130.583	135,167	139.833
27	115,708	122,208	126,500	130.625	135,208	139.792
28	116,667	125,500	134,083	144.000	154,875	166.000
29	116,167	134,292	145,750	156.792	167,917	178,792
30	116,667	159,042	181,958	200.292	215.625	228.875
31	115,167	126,833	127,6[illegible]	127.792	129,167	130.708
32	115,167	126,833	127,667	127.792	129,167	130.708
33	115,375	119,583	120,833	121.667	122,750	124.125
34	112,375	114,833	116,583	117.917	118,958	120.208

Table 5.6-2a. 6 IN. DIA TANK TEST 8G #4 (Page 2 of 2)

35	108,917	110,375	111,792	113.042	114,167	115.333
36	115,167	126,833	127,667	127.792	129,167	130.708
37	117,000	126,458	137,917	151.000	165,167	178.500
38	117,083	122,917	129,292	142,333	155,250	167.750
39	117,083	123,458	129,542	138,792	148,583	158.542
40	117,458	123,250	129,042	134,208	140,208	146.000
41	117,417	121,292	124,708	128,542	131,917	136.000
42	117,375	121,375	125,750	129.750	132,917	136,083
43	117,500	121,667	125,250	128,542	132,542	136.500
44	117,542	123,042	126,583	129,333	132,250	135.500
45	117,458	121,417	124,583	128.375	131,875	135,833
46	117,417	122,417	125,875	129.583	133,292	137.125
47	117,500	122,958	126,292	129,292	133,250	137,250
48	118,000	121,833	125,208	127,917	131,375	134.750
49	116,542	119,500	122,583	126,042	128,875	131.500
50	116,875	119,792	122,750	125.542	128,625	131.375
51	116,458	118,917	121,750	124,750	127,333	130.000
52	117,208	119,792	122,417	125,188	128,063	130.521
53	116,333	119,500	121,542	123,958	127,000	129.667
54	117,958	120,667	123,083	125.625	128,792	131.042
55	117,708	120,875	123,375	126.250	129,250	131,708
56	117,958	120,667	123,083	125,625	128,792	131.042
57	117,708	120,875	123,375	126.250	129,250	131.708
58	116,417	119,208	121,333	123,708	126,458	128.875
59	117,417	119,667	122,083	124,456	127,042	129.167
60	118,833	120,875	123,083	125,333	127,792	129.792
61	116,000	116,792	118,625	120.500	123,292	125.125
62	115,833	116,792	118.333	120.417	122,458	124.583
63	116,958	117,833	119,667	121.417	123,917	126.208
64	118,208	119,083	120,792	122.417	123,875	125.875
65	115,917	116,125	117,333	118,708	121,083	122,583
66	116,042	116,125	116,917	118.667	120,292	121.708
67	116,792	116,958	117,750	119.500	121,208	122,708
68	117,750	118,000	118,625	119,792	121,500	123.125
69	115,875	115,750	116,208	117.417	118,958	120.417
70	115,958	116,000	116.500	117.458	119,125	120.417
71	116,333	116,583	117.125	118.375	119,667	121.375
72	117,375	118,042	118,833	120,083	121,375	122.917
73	115,042	116,042	117,167	117,750	119,667	121,250
74	107,125	108,417	109,750	111.500	113,833	116,042
75	93,333	93,417	93,500	93.625	94,125	94,667
76	105,583	105,792	106,333	107.042	108,000	108.958
77	91,750	91,417	91,042	90.792	90.958	90.958

Table 5.6-2b. 6 IN. DIA TANK TEST 8G #6 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.833	1.500	2.500	3.167	3.800
TAU	0.000	.219	.395	.658	.833	1.000
1	117.125	123.542	128.500	135.792	141.208	145.792
2	117.417	129.292	133.667	139.250	142.792	145.875
3	117.583	127.417	131.833	136.708	139.667	142.333
4	117.875	127.250	131.458	135.708	138.375	140.958
5	117.250	125.417	129.500	133.458	135.875	138.125
6	117.042	125.792	129.125	132.625	135.042	137.208
7	117.417	126.375	128.667	132.333	134.333	136.417
8	117.458	126.125	126.167	132.625	134.500	136.500
9	116.083	120.125	121.792	124.250	126.125	127.667
10	117.167	128.125	132.458	137.250	140.583	143.750
11	117.375	128.625	131.833	136.375	139.125	141.500
12	117.708	129.458	131.583	135.500	137.833	139.708
13	117.000	127.833	129.625	132.042	133.583	135.458
14	116.500	121.583	125.667	131.333	135.458	140.167
15	116.667	125.750	129.750	133.958	137.375	140.625
16	117.167	126.167	130.125	133.625	135.875	139.042
17	116.667	122.958	126.417	129.875	132.000	134.167
18	115.958	122.917	125.167	128.542	130.125	132.042
19	115.750	118.833	120.583	123.292	125.208	126.833
20	117.167	128.125	132.458	137.250	140.583	143.750
21	117.375	128.625	131.833	136.375	139.125	141.500
22	117.708	129.458	131.583	135.500	137.833	139.708
23	117.000	127.833	129.625	132.042	133.583	135.458
24	116.833	145.833	166.167	191.208	205.542	218.542
25	116.583	121.542	126.458	140.375	150.333	159.042
26	116.542	120.833	124.833	130.708	134.792	138.917
27	116.583	120.875	124.875	130.667	134.833	138.958
28	117.000	123.792	132.125	147.042	157.958	169.083
29	116.667	131.917	143.250	160.000	171.042	181.875
30	117.000	153.792	177.792	206.125	221.458	235.292
31	116.431	127.194	128.264	129.278	130.750	132.292
32	117.208	128.167	129.375	130.083	131.417	133.125
33	115.083	118.833	120.500	121.958	123.167	124.583
34	111.125	112.708	114.458	116.583	117.917	119.125

Table 5.6-2b. 6 IN. DIA ΓANK TEST 8G #6 (Page 2 of 2)

35	106.625	107.583	108.708	110.625	111.917	112.958
~~36~~	~~116.042~~	~~126.708~~	~~127.708~~	~~128.875~~	~~130.417~~	~~131.875~~
37	117.167	124.417	135.583	155.708	168.333	180.583
38	117.000	121.917	127.208	146.292	158.542	171.542
39	117.208	122.125	127.750	141.583	151.500	161.708
40	117.458	121.792	127.208	135.250	[illegible]41.458	152.458
41	117.167	121.583	125.500	131.625	1[illegible].375	139.250
~~42~~	~~117.125~~	~~121.625~~	~~125.500~~	~~131.542~~	~~13[illegible].958~~	~~139.458~~
43	117.333	121.792	125.750	131.500	135.917	139.583
44	117.458	122.000	125.917	132.125	136.083	139.792
~~45~~	~~117.292~~	~~121.708~~	~~125.792~~	~~131.750~~	~~135.667~~	~~139.333~~
46	117.417	121.875	126.125	132.042	135.958	140.417
47	117.833	122.583	126.708	132.042	135.792	139.667
~~48~~	~~118.167~~	~~121.125~~	~~124.833~~	~~129.667~~	~~133.083~~	~~136.333~~
49	116.917	119.625	122.250	127.250	130.417	133.042
50	117.208	119.542	122.375	127.417	130.000	132.500
~~51~~	~~117.000~~	~~119.208~~	~~121.625~~	~~126.292~~	~~128.792~~	~~131.167~~
52	117.688	119.896	122.625	126.833	129.271	131.750
53	116.875	119.375	121.958	126.000	128.333	130.750
~~54~~	~~118.375~~	~~120.583~~	~~123.625~~	~~127.375~~	~~129.750~~	~~132.333~~
55	118.250	120.750	123.125	127.667	130.167	132.875
56	118.375	120.583	123.625	127.375	129.750	132.333
~~57~~	~~118.250~~	~~120.750~~	~~123.125~~	~~127.667~~	~~130.167~~	~~132.875~~
58	116.917	119.208	121.375	125.500	127.917	130.375
59	118.042	119.667	121.917	126.083	128.292	130.792
~~60~~	~~119.250~~	~~120.542~~	~~122.792~~	~~126.792~~	~~129.000~~	~~131.375~~
61	116.542	117.042	118.958	121.958	124.125	125.917
62	116.792	117.083	118.708	122.042	123.583	125.583
~~63~~	~~117.500~~	~~117.958~~	~~119.625~~	~~123.208~~	~~124.958~~	~~126.833~~
64	118.500	119.000	120.625	122.917	124.792	126.708
65	116.375	116.292	117.542	120.083	121.708	123.417
~~66~~	~~116.500~~	~~116.417~~	~~117.000~~	~~119.542~~	~~120.917~~	~~122.208~~
67	117.167	117.125	117.792	120.500	121.875	123.375
68	118.083	118.083	118.417	120.458	121.625	123.625
~~69~~	~~116.167~~	~~116.042~~	~~116.542~~	~~118.375~~	~~119.750~~	~~121.000~~
70	116.333	116.375	116.708	118.417	119.875	121.125
71	116.708	116.958	117.417	119.292	120.875	121.833
~~72~~	~~117.500~~	~~118.208~~	~~119.125~~	~~120.958~~	~~122.042~~	~~123.417~~
73	115.417	116.917	117.167	119.042	120.583	121.625
74	108.458	109.458	111.083	114.417	116.917	119.708
~~75~~	~~94.833~~	~~95.000~~	~~95.208~~	~~95.875~~	~~96.292~~	~~96.833~~
76	106.125	106.250	106.792	107.958	108.750	109.542
77	92.708	92.375	92.208	92.083	91.875	91.708

Table 5.6-2c. 12 IN. DIA TANK TEST 1G #23 (Page 1 of 2)

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                                    TEMPERATURE MATRIX=STRATIFICATION

   TIME(MIN)     0,000     3,000     6,000     9,000    12,000    15,000
  TAU            0,000      ,200      ,400      ,600      ,800     1,000
     1         116,875   122,500   126,250   129,750   133,000   136,175
     2         116,875   124,375   127,958   131,125   134,125   137,167
     3         117,167   125,458   128,625   131,542   134,458   137,308
     4         117,417   125,000   127,875   130,750   133,542   136,425
     5         117,167   125,333   128,208   130,792   133,583   136,413
     6         117,167   123,833   126,250   129,042   131,542   134,196
     7         117,208   123,333   125,667   128,292   130,708   133 242
     8         117,292   123,750   125,958   128,292   130,458   132,983
     9         116,750   120,667   123,333   125,708   127,917   130,304
    10         116,958   129,258   133,167   136,333   139,417   142,600
    11         117,125   129,625   132,792   135,542   138,375   141,342
    12         117,250   128,583   131,125   133,958   136,458   139,196
    13         117,083   129,458   131,417   133,563   135,958   138,425
    14         116,542   122,458   126,083   129,458   132,750   135,988
    15         117,042   128,625   132,125   135,208   138,083   141,354
    16         117,208   127,833   130,542   133,208   136,125   139,263
    17         117,000   127,583   130,292   133,000   135,542   138,208
    18         116,958   126,500   128,500   130,792   133,083   135,675
    19         116,500   120,167   122,333   124,792   127,000   129,458
    20         117,375   130,083   133,292   136,458   139,458   142,796
    21         117,167   130,083   132,875   135,708   138,583   141,467
    22         117,042   126,792   131,125   134,000   136,500   139,442
    23         117,083   129,083   130,833   132,958   135,375   137,985
    24         116,792   136,458   150,958   158,875   166,125   171,408
    25         116,542   124,375   133,958   143,625   152,583   160,354
    26         116,458   122,167   129,542   137,458   145,167   152,862
    27         116,500   122,208   129,417   137,375   149,167   152,858
    28         116,792   135,083   157,167   180,167   204,958   223,883
    29         116,500   126,708   143,167   158,292   173,333   190,456
    30         116,583   145,750   169,167   186,333   199,292   210,517
    31         117,333   128,458   130,417   132,667   134,917   137,413
    32         117,125   127,542   129,208   131,292   133,500   135,963
    33         115,500   119,750   121,292   123,000   124,833   126,917
   ▼34         115,250   114,958   115,292   115,875   116,625   117,496
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Table 5.6-2c. 12 IN. DIA TANK TEST 1G #23 (Page 2 of 2)

35	115,167	114,083	113,458	113,125	112,958	112,800
36	117,708	128,708	130,667	132,750	135,167	137,638
37	117,208	129,708	151,417	174,750	194,458	214,237
38	117,125	125,083	138,750	150,875	164,875	180,412
39	117,208	122,500	129,833	137,792	145,792	157,979
40	117,333	121,625	127,333	132,625	136,667	141,553
41	117,375	119,833	122,667	125,792	128,875	132,458
42	117,292	119,958	123,208	126,500	129,708	133,250
43	117,417	120,167	123,250	126,500	129,750	133,283
44	117,583	120,250	123,500	126,708	130,042	133,554
45	117,375	119,792	123,292	126,500	129,667	133,296
46	117,250	120,708	123,958	127,208	130,208	133,796
47	117,500	120,167	123,417	126,708	129,917	133,504
48	117,667	120,083	123,083	126,375	129,417	132,988
49	117,625	119,750	122,625	125,875	128,833	132,375
50	117,542	119,375	122,167	125,417	128,250	131,763
51	117,375	119,000	121,250	124,125	126,792	130,463
52	117,208	119,542	122,083	125,333	127,917	131,592
53	117,125	119,583	122,333	125,583	128,083	131,738
54	117,458	119,583	122,250	125,417	128,000	131,713
55	117,250	119,583	122,167	125,417	127,958	131,629
56	117,333	119,375	122,083	125,250	127,792	131,521
57	117,167	119,625	122,333	125,458	128,208	131,950
58	117,375	119,250	121,792	124,958	127,583	131,221
59	117,167	119,042	121,417	124,583	127,125	130,775
60	117,042	118,875	121,208	124,375	126,708	130,388
61	117,167	118,583	120,667	123,458	125,833	129,308
62	117,375	118,625	120,708	123,500	125,917	129,417
63	117,042	118,458	120,417	123,333	125,625	129,113
64	116,875	118,250	120,125	122,875	124,875	128,375
65	117,042	118,250	120,167	122,875	125,167	128,433
66	117,042	118,250	119,625	122,208	124,208	127,475
67	116,958	117,917	119,625	122,208	124,208	127,475
68	116,917	117,875	119,292	121,792	123,667	126,929
69	117,000	117,875	119,375	121,833	123,792	126,933
70	116,917	117,833	119,083	121,458	123,417	126,633
71	116,917	117,833	119,083	121,458	123,417	126,633
72	116,958	117,792	119,167	121,667	123,833	126,804
73	116,958	118,000	119,292	121,542	123,542	133,529
74	93,667	94,042	94,375	95,333	95,875	97,208
75	104,625	105,750	107,083	109,208	110,917	114,000
76	86,792	87,083	86,792	87,208	86,917	87,083
77	97,958	98,250	98,083	98,792	99,000	99,833

Table 5.6-2d. 12 IN. DIA TANK TEST 1G #28 (Page 1 of 2)

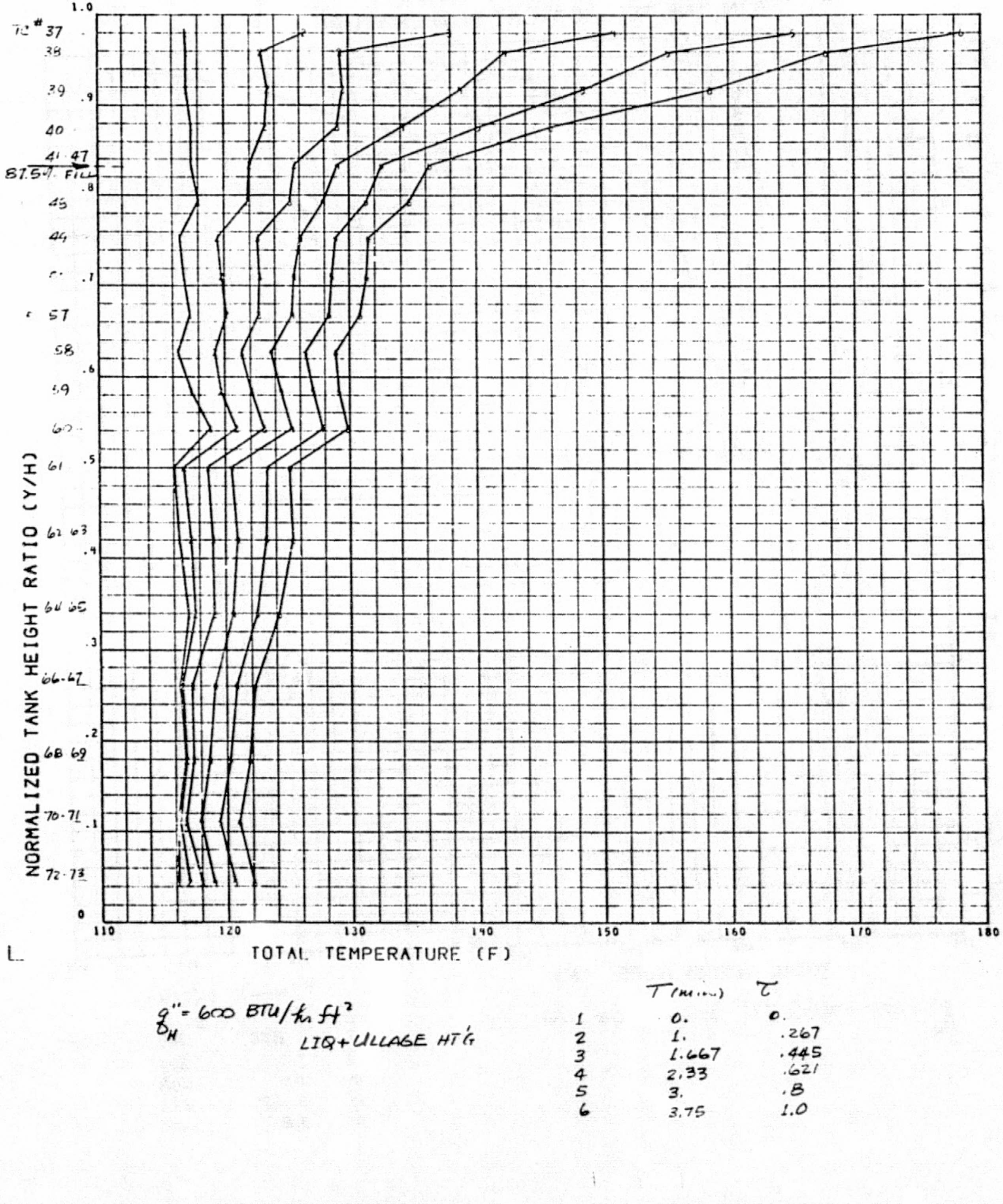
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	3.000	6.000	9.000	12.000	15.000
TAU	0.000	.200	.400	.600	.800	1.000
1	117.000	122.708	126.500	129.875	133.208	136.708
2	116.958	124.500	128.167	131.125	134.125	137.042
3	117.333	125.375	128.625	131.458	134.208	137.042
4	117.500	125.125	127.958	130.583	133.333	136.208
5	117.292	125.250	128.208	130.792	133.292	136.250
6	117.250	123.667	126.250	128.667	131.125	133.833
7	117.333	123.542	125.833	128.167	130.417	133.000
8	117.417	123.708	126.000	128.000	130.292	132.583
9	116.833	120.667	123.333	125.458	127.583	130.042
10	117.167	129.875	133.292	136.250	139.208	142.292
11	117.292	129.792	132.667	135.458	138.042	140.917
12	117.375	128.667	131.208	133.542	136.125	138.917
13	117.167	129.708	131.375	133.458	135.542	137.958
14	116.792	122.917	126.625	129.833	132.958	136.292
15	117.083	128.458	132.208	135.333	138.042	141.000
16	117.333	127.792	130.958	133.417	136.125	139.042
17	117.125	127.542	129.958	132.542	135.042	137.708
18	117.000	126.292	128.583	130.375	132.708	134.958
19	116.583	120.042	122.583	124.583	126.750	129.083
20	117.292	130.042	133.500	136.292	139.167	142.333
21	117.125	129.917	132.667	135.417	138.167	141.083
22	117.083	128.500	131.250	133.792	136.208	138.875
23	117.083	128.875	130.917	132.917	134.958	137.375
24	116.875	136.292	150.625	158.917	165.458	170.292
25	116.625	124.083	133.375	142.750	151.500	158.875
26	116.500	121.792	129.042	136.625	144.167	151.083
27	116.542	121.917	128.917	136.583	144.208	151.125
28	116.833	134.833	157.000	179.625	201.250	220.958
29	116.583	128.542	143.125	158.000	173.292	188.667
30	116.667	145.292	169.750	187.750	201.583	212.750
31	117.042	128.333	130.583	132.458	134.583	136.917
32	116.875	127.375	129.333	131.250	133.208	135.667
33	115.375	119.708	121.458	122.875	124.500	126.458
34	115.083	114.875	115.333	115.583	115.917	116.708

Table 5.6-2d. 12 IN. DIA TANK TEST 1G #28 (Page 2 of 2)

35	115.000	113.917	113.500	112.833	112.458	112.333
▼ 36	117.375	128.750	130.708	132.750	134.792	137.208
37	117.167	130.208	152.250	174.958	195.083	212.583
38	117.167	125.500	140.500	152.292	166.333	180.250
39	117.167	122.208	129.333	137.083	146.042	157.833
40	117.250	122.292	129.375	136.958	142.750	148.667
41	117.500	119.625	122.833	125.917	128.958	132.250
42	117.500	120.083	123.542	126.667	129.708	132.958
43	117.583	120.250	123.542	126.708	129.708	132.917
44	117.833	120.125	124.083	126.917	130.000	133.250
45	117.542	119.958	123.708	126.750	129.667	132.958
46	117.417	120.875	124.083	127.542	130.333	133.375
47	117.708	120.417	123.750	127.042	130.125	133.125
48	117.917	120.042	123.250	126.500	129.417	132.542
49	117.771	119.708	122.833	125.938	128.813	131.854
50	117.625	119.375	122.417	125.375	128.208	131.167
51	117.667	119.125	121.583	124.250	126.917	129.708
52	117.625	119.417	122.375	125.375	128.000	130.958
53	117.333	119.667	122.875	125.542	128.208	131.167
54	117.708	119.708	122.542	125.458	128.167	131.042
55	117.542	119.583	122.458	125.292	128.042	130.917
56	117.667	119.417	122.333	125.208	128.000	130.750
57	117.542	119.667	122.583	125.417	128.208	130.917
58	117.708	119.375	122.125	125.000	127.625	130.500
59	117.458	119.125	121.833	124.667	127.208	129.958
60	117.333	118.958	121.542	124.375	126.833	129.542
61	117.542	118.708	120.958	123.625	125.917	128.458
62	117.625	118.750	120.958	123.542	125.917	128.542
63	117.375	118.542	120.833	123.333	125.708	128.250
64	117.292	118.250	120.417	122.875	125.000	127.458
65	117.375	118.292	120.458	122.917	125.083	127.583
66	117.306	118.056	120.014	122.292	124.361	126.708
67	117.333	118.042	119.958	122.250	124.292	126.625
68	117.292	117.875	119.667	121.750	123.792	126.042
69	117.375	117.917	119.833	121.792	123.875	126.167
70	117.264	117.833	119.597	121.639	123.667	125.889
71	117.250	117.792	119.542	121.542	123.542	125.833
72	117.250	117.833	119.583	121.625	123.667	125.792
73	117.292	117.917	119.500	121.708	123.500	126.000
74	96.125	96.292	96.958	97.708	98.500	99.500
75	106.125	107.042	108.833	110.833	112.833	115.208
76	87.792	87.875	87.958	88.042	87.917	87.958
77	98.375	98.375	98.750	99.125	99.417	99.958

FIGURE 5.6-1a
6 IN. TNK TEST 8GΣ4 – STRAT TEMPERATURE PROFILE

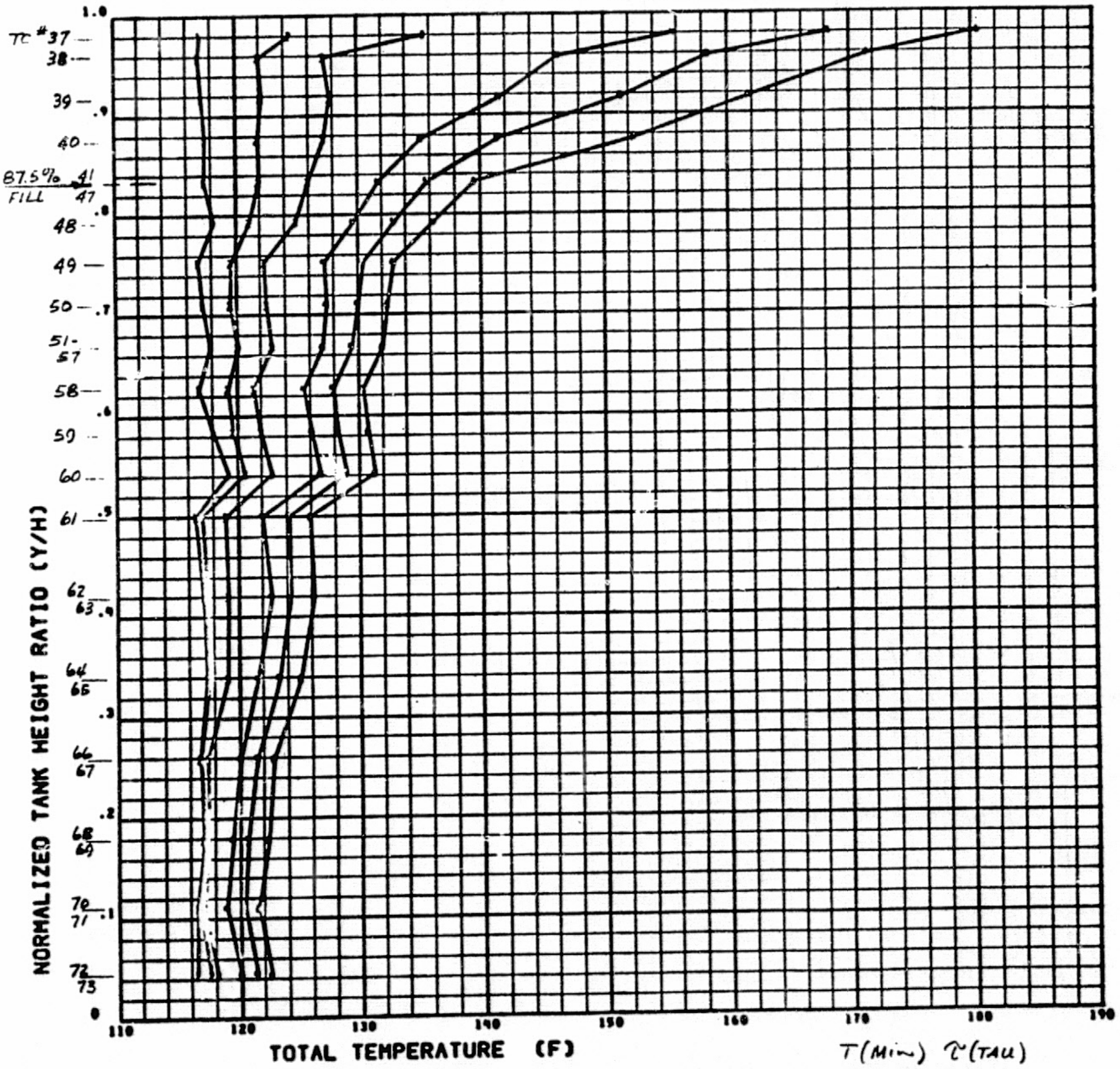


q''_H = 600 BTU/hr ft²

LIQ+ULLAGE HT'G

	T (min)	τ
1	0.	0.
2	1.	.267
3	1.667	.445
4	2.33	.621
5	3.	.8
6	3.75	1.0

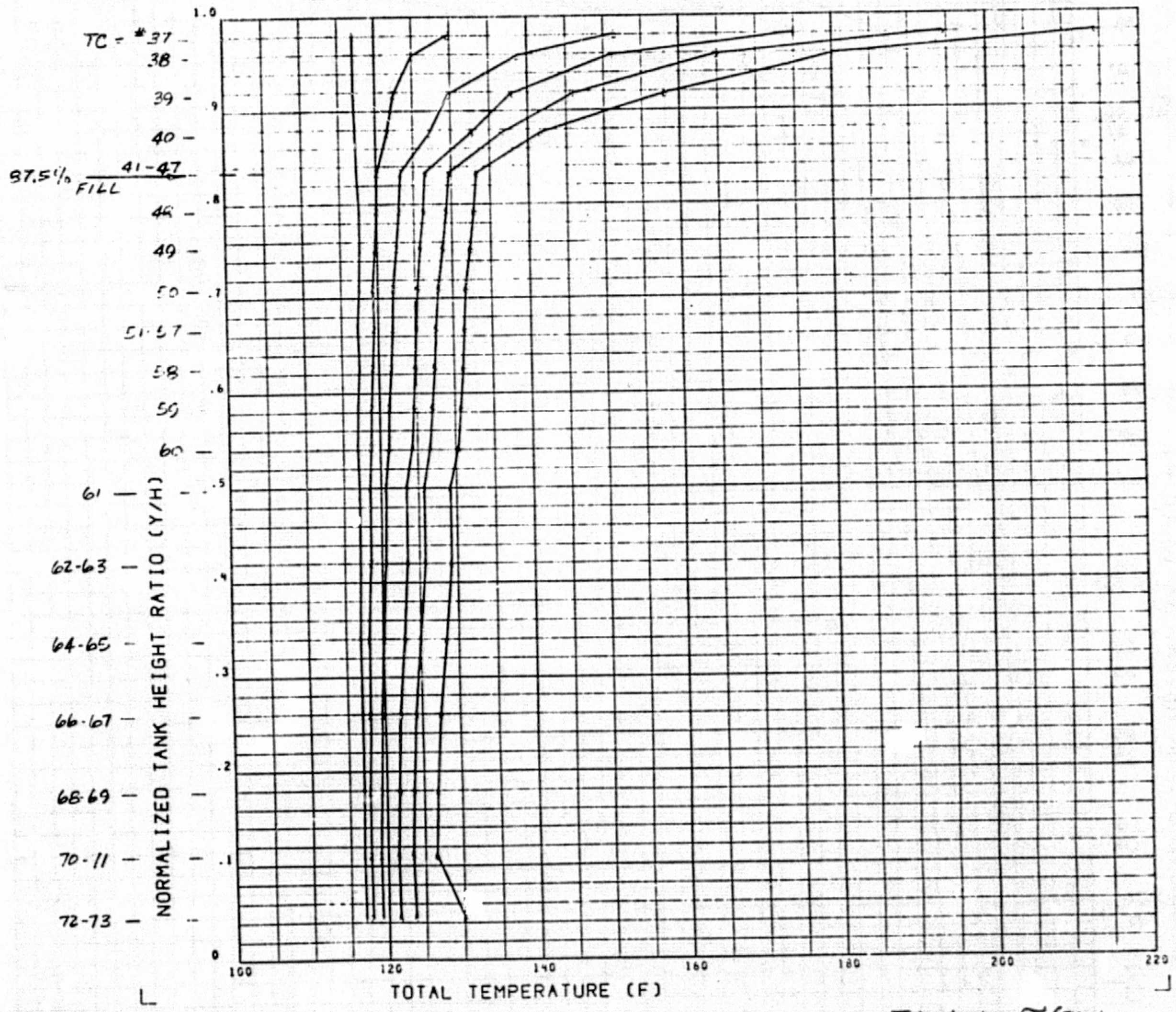
FIGURE 5.6-1b
6 IN. TNK TST8G6 STRAT TEMPERATURE PROFILE



q''_H = 600 BTU/hr ft² LIQ + ULGE HTG.

	T(Min)	τ(TAU)
1	0.	0.
2	.833	.219
3	1.5	.395
4	2.5	.658
5	3.167	.833
6	3.8	1.000

FIGURE 5.6-1c
12 IN. INK TEST 1GΣ23 – STRAT TEMPERATURE PROFILE

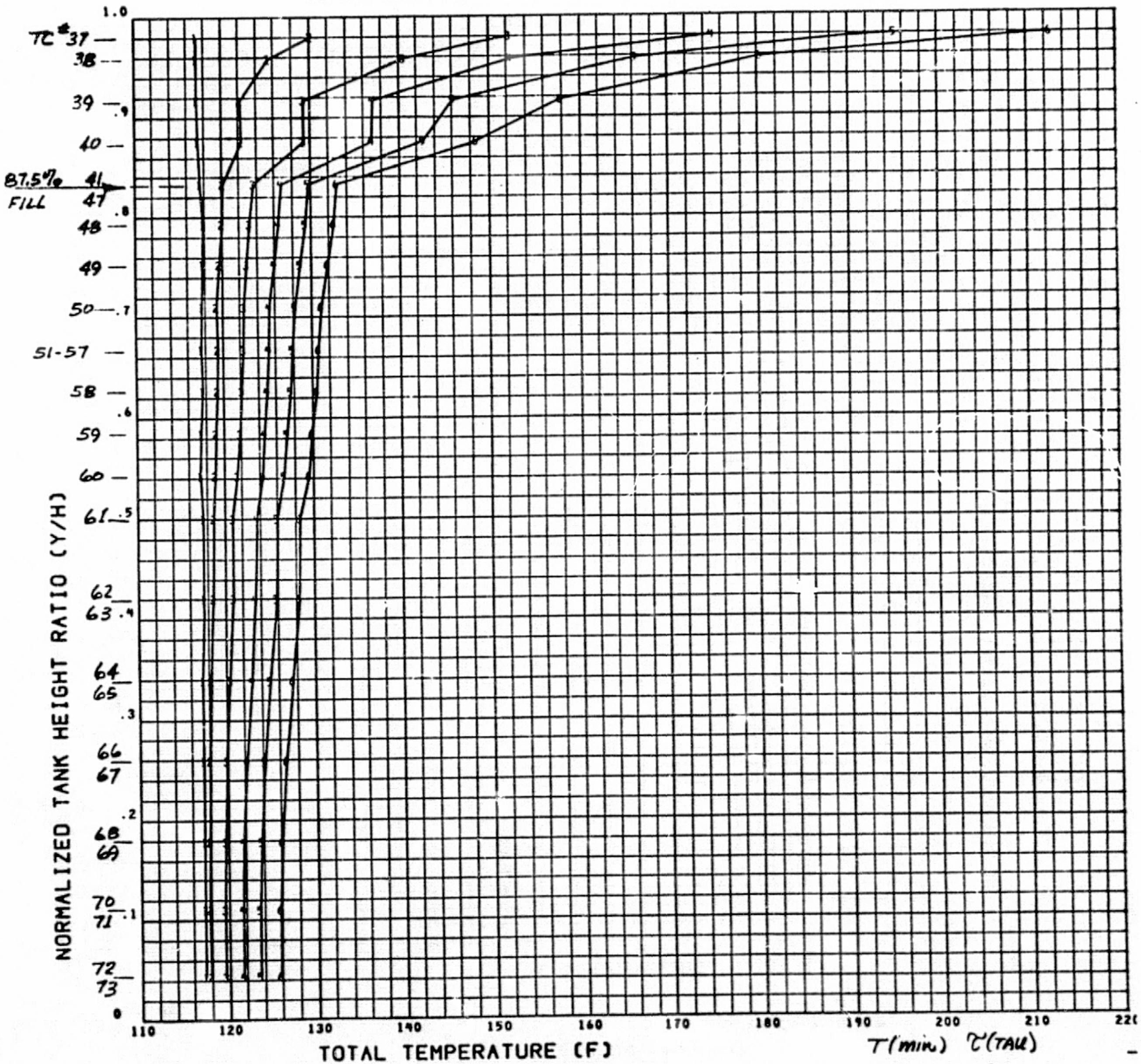


q''_H = 300 BTU/hr ft²

LIQ + ULLAGE HT'G

	T (min)	τ (TAU)
1	0.0	0.0
2	3.	.2
3	6.	.4
4	9.	.6
5	12.	.8
6	15.	1.0

FIGURE 5.6-1d
12 IN. TNK TST1G28 STRAT TEMPERATURE PROFILE



q''_{D_H} = 300 BTU/hr ft^2 LIQ + ULLAGE HTG

	T(min)	τ(TAU)
1	0.	0.
2	3.	.2
3	6.	.4
4	9.	.6
5	12.	.8
6	15.	1.0

FIGURE 5.6-2a

6 [illegible] TNK TEST 8GΣ4 – STRAT DEL – TEMP PROFILE

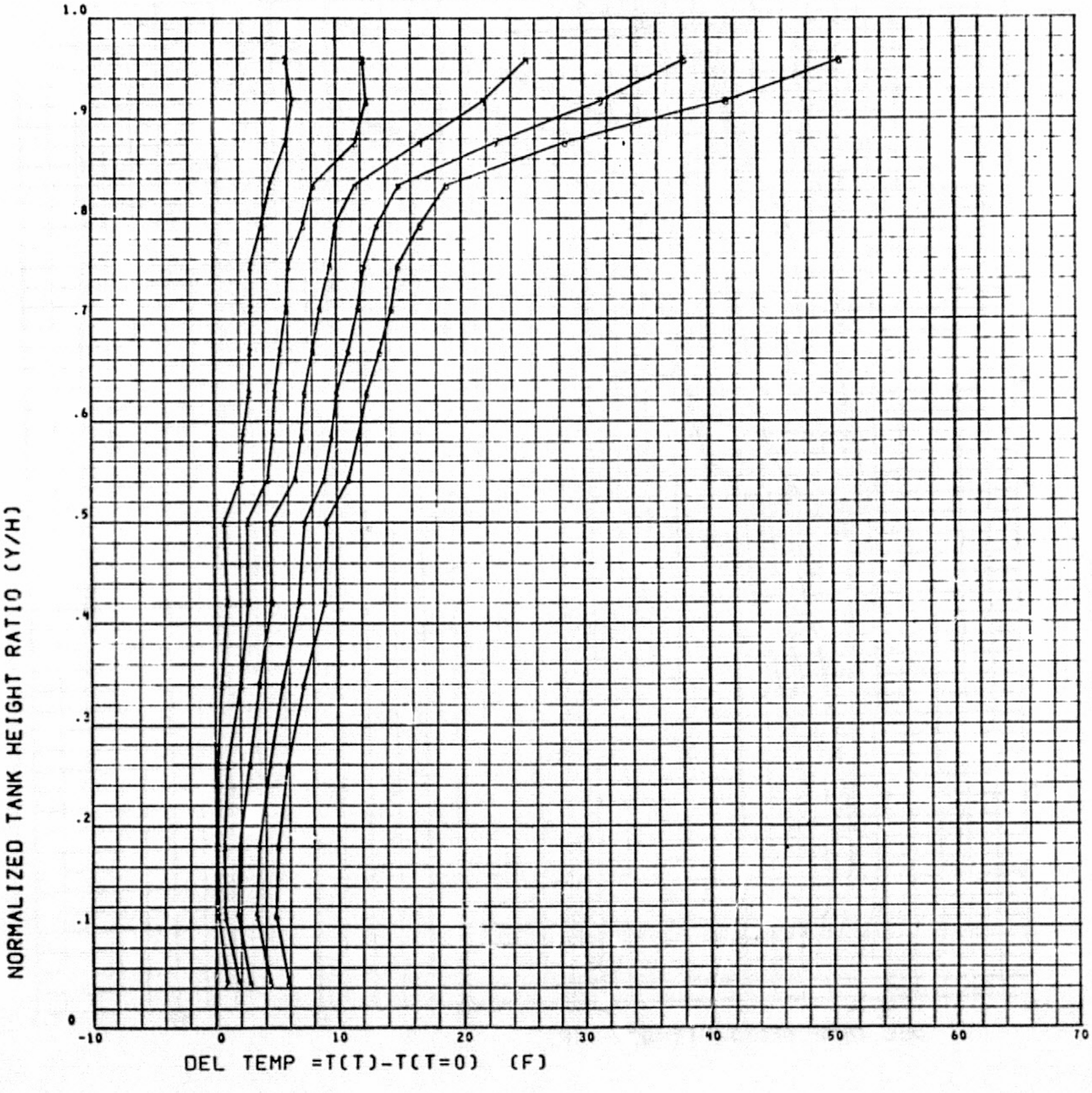


FIGURE 5.6-2b
6 IN. TNK TST8G6 STRAT DEL – TEMP PROFILE

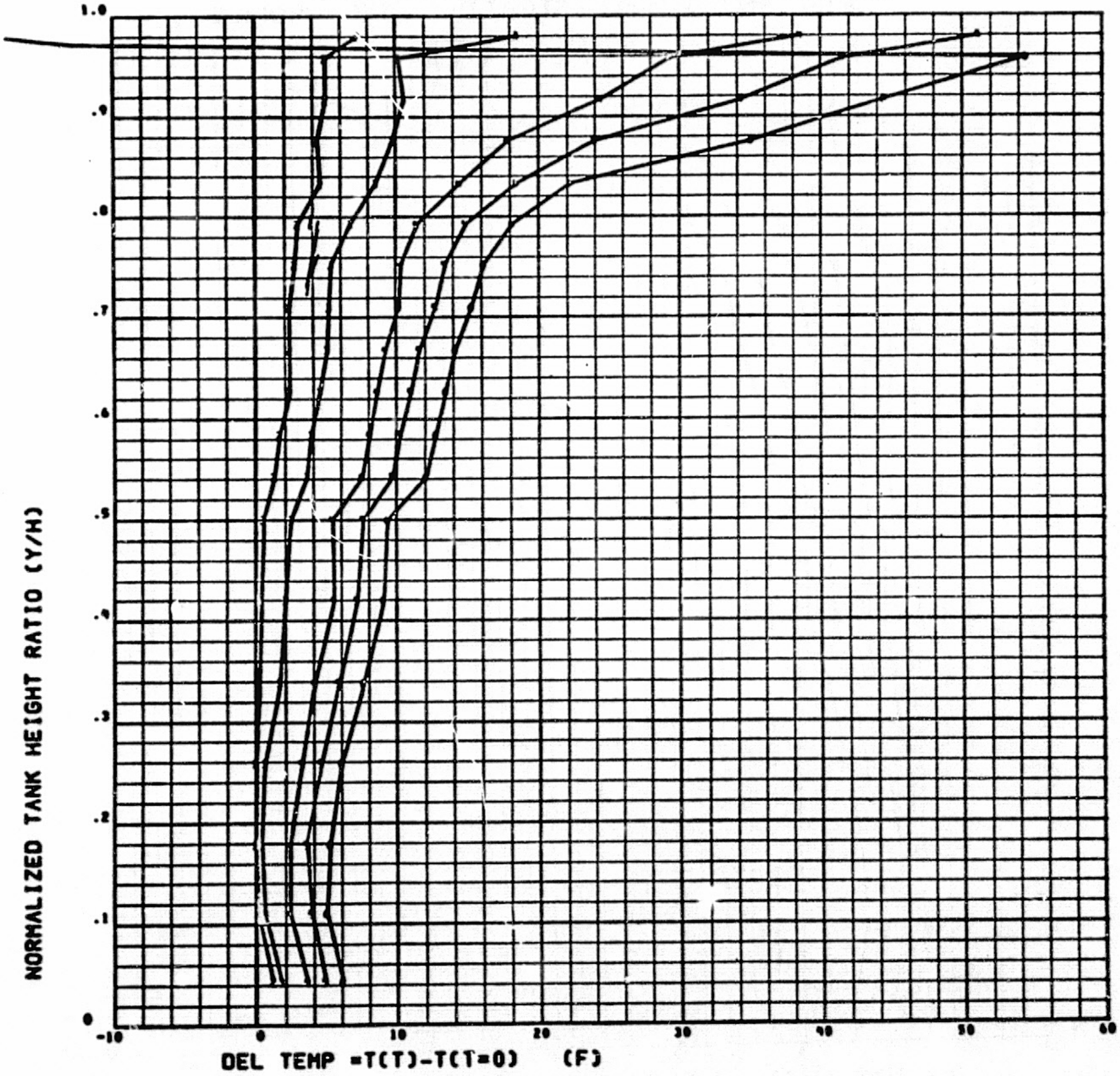


FIGURE 5.6-2c
12 IN. TNK TEST 1GΣ23 – STRAT DEL – TEMP PROFILE

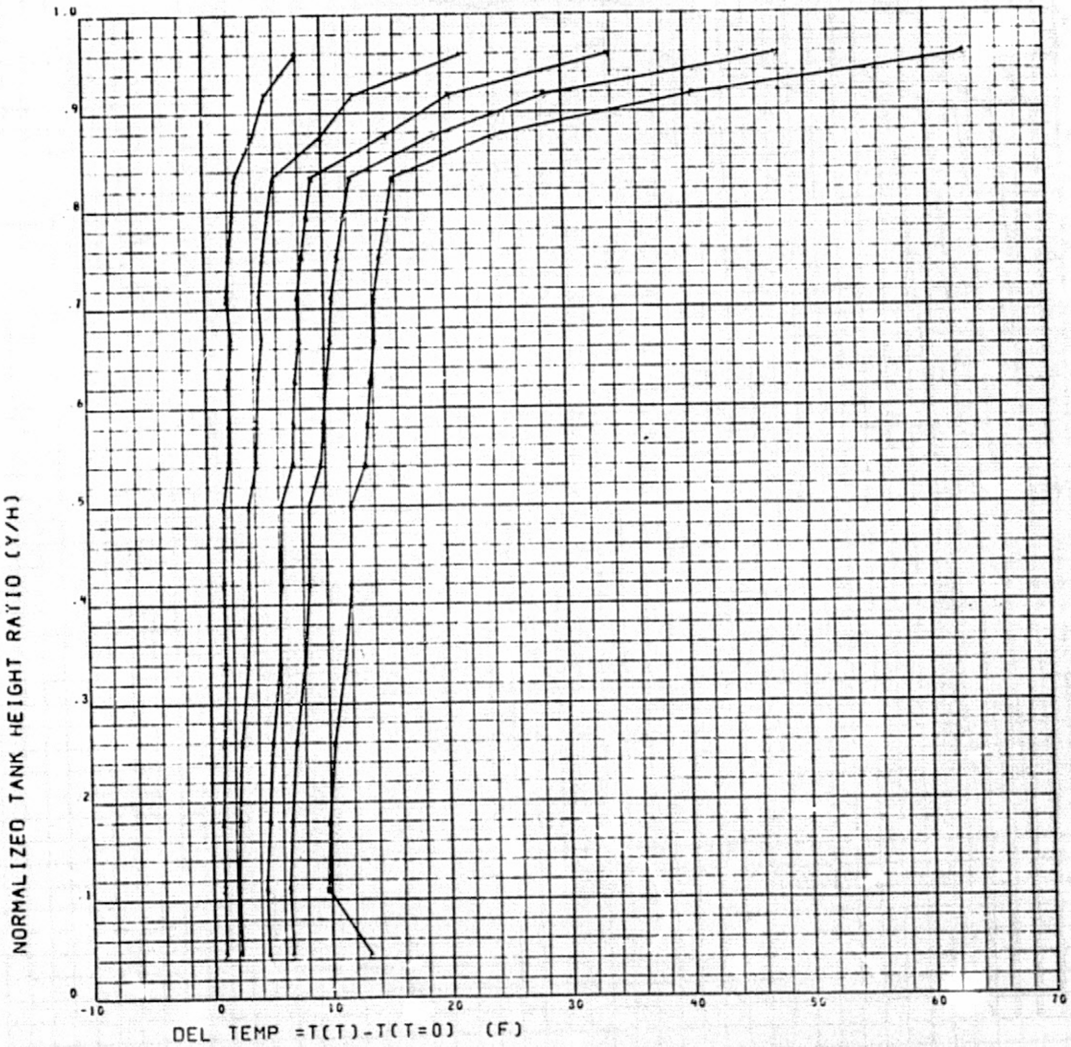


FIGURE 5.6-2d
12 IN' TNK TST1G28 STRAT DEL – TEMP PROFILE

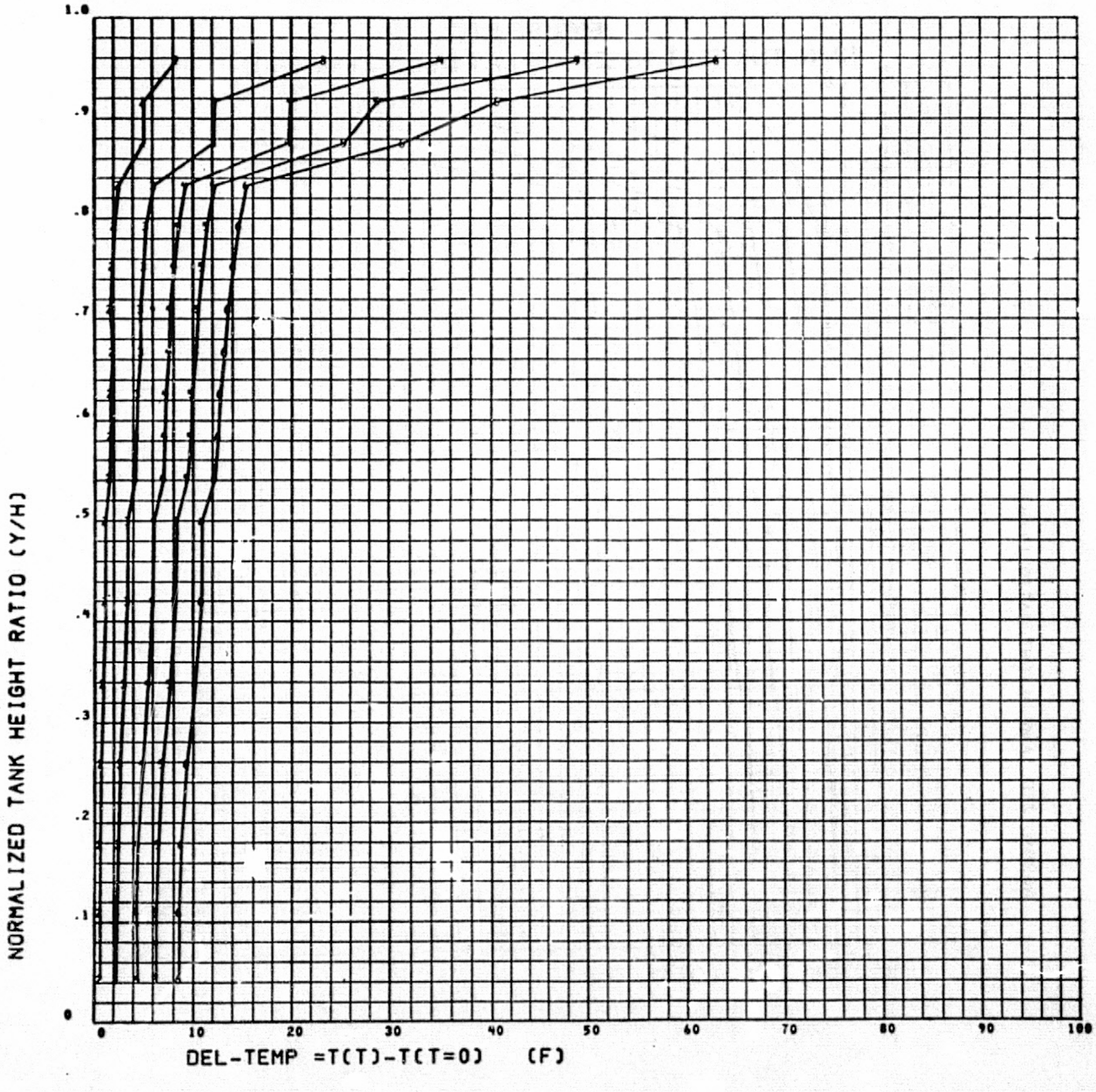


FIGURE 5.6-3a

6 IN. TANK TEST 8GΣ4 – STRAT DTNORM PROFILE

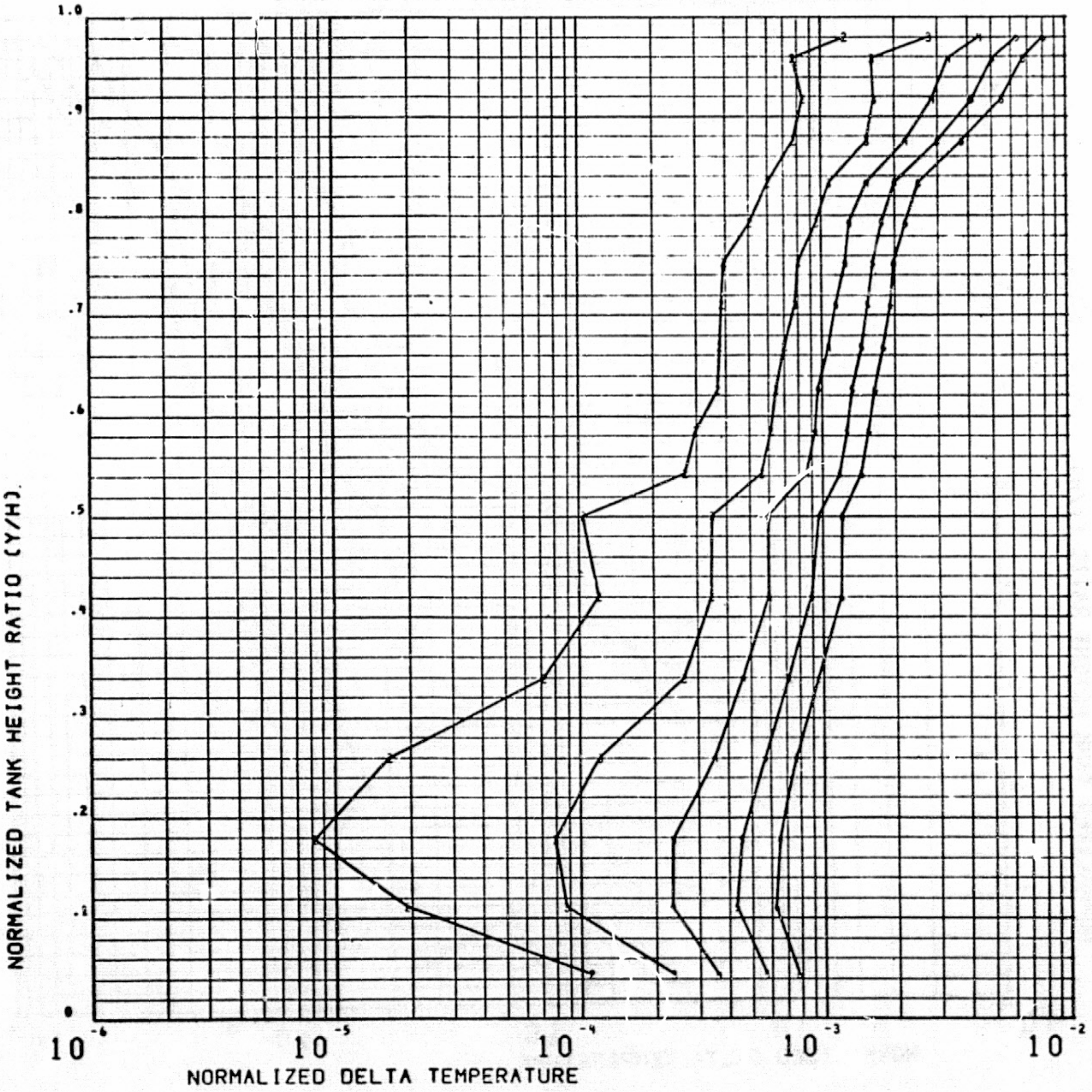


FIGURE 5.6-3b

6 IN. TNK TST8G6 STRAT DTNORM PROFILE

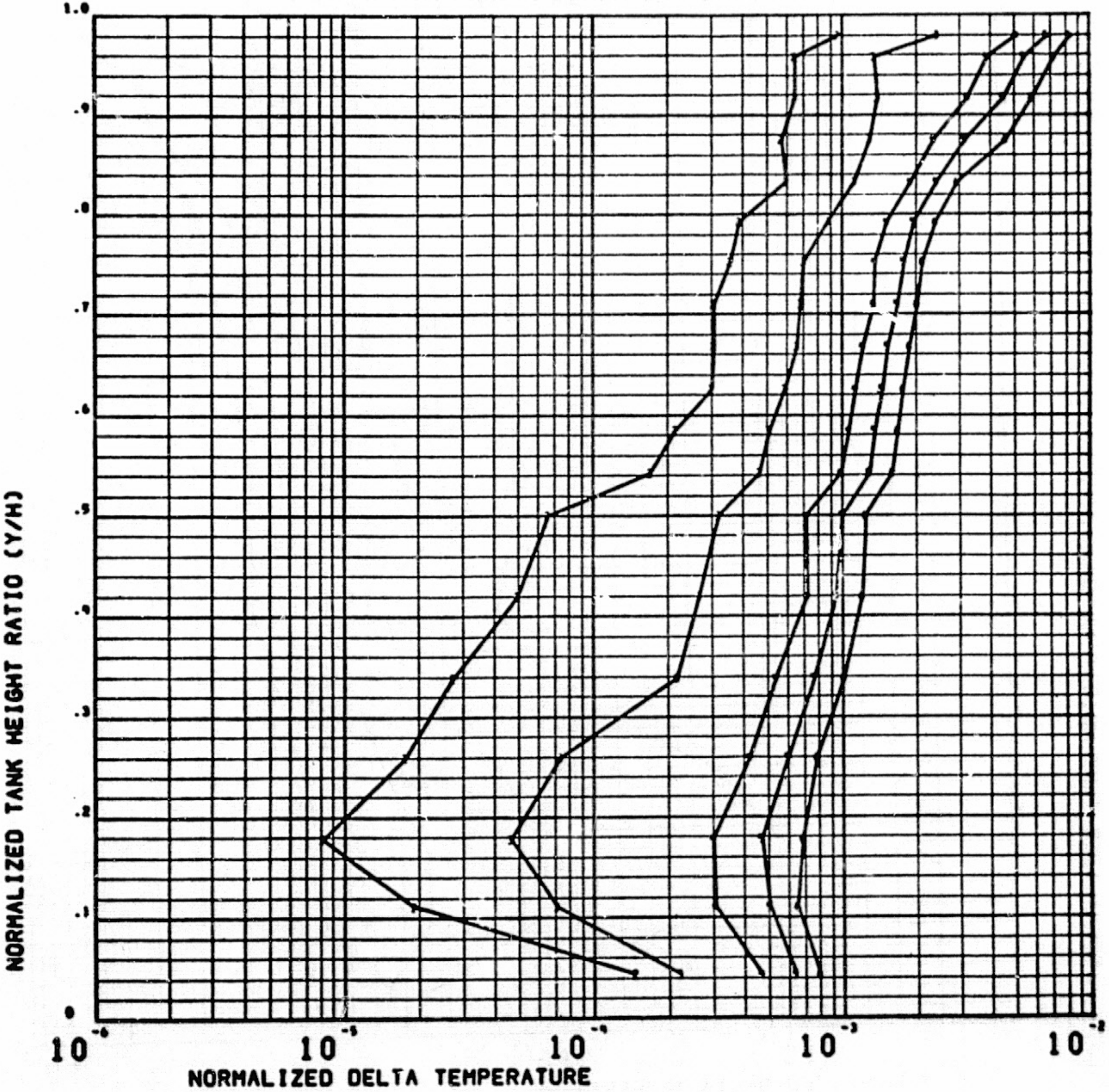


FIGURE 5.6-3c
12 IN. TNK TEST 1GΣ23 – STRAT DTNORM PROFILE

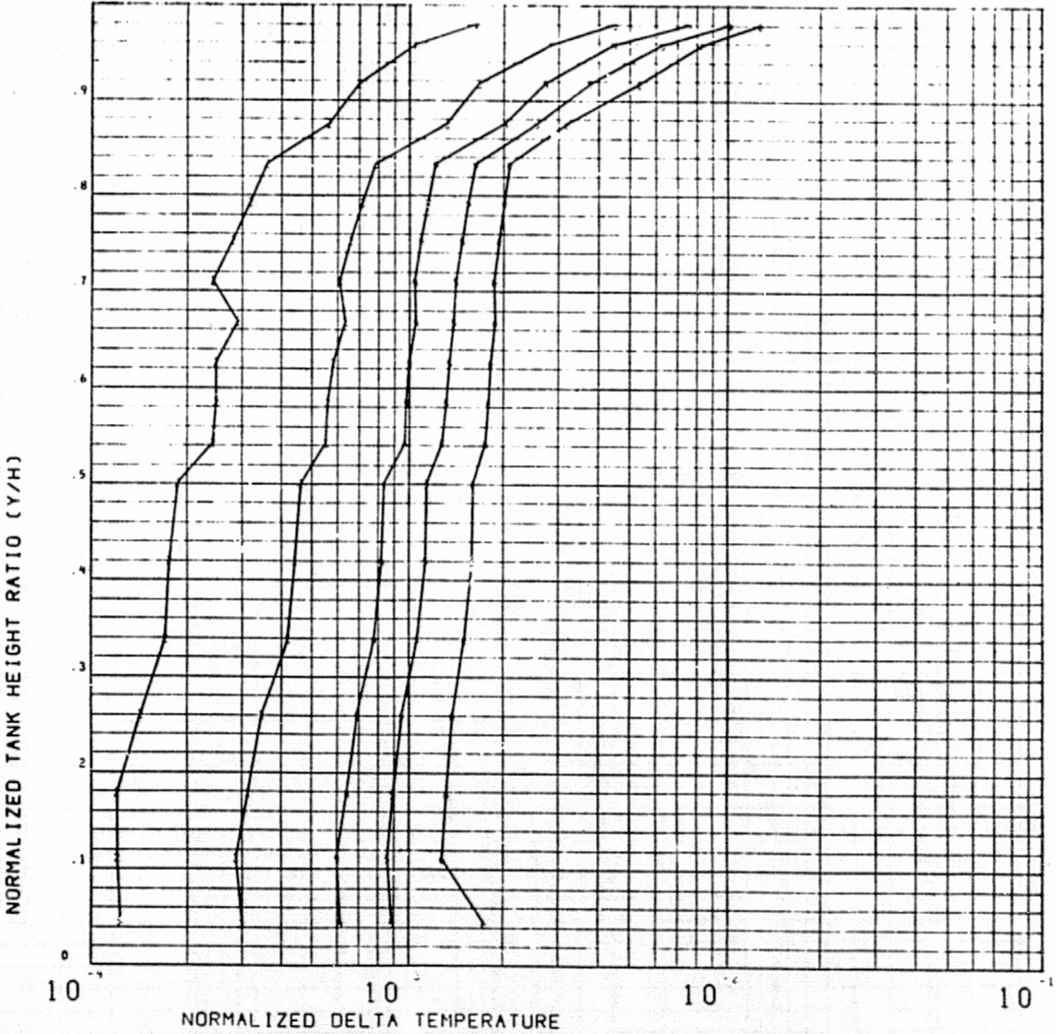


FIGURE 5.6-3d

12 IN. TNK TST1G28 STRAT DTNORM PROFILE

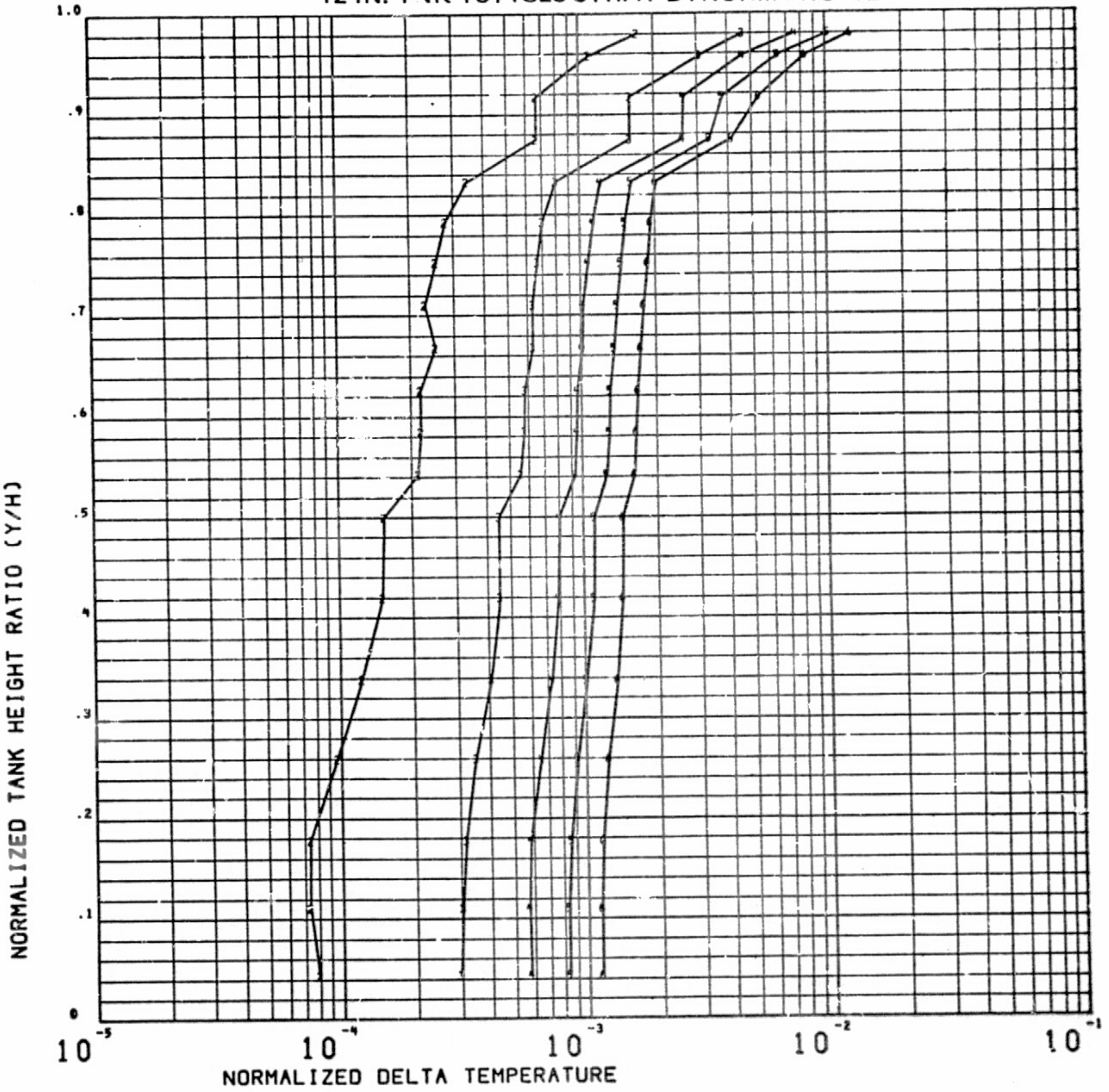


FIGURE 5.6-4a
6 IN. TNK TEST 8GΣ4 – BULK ULGE/LIQ TEMP HISTORIES

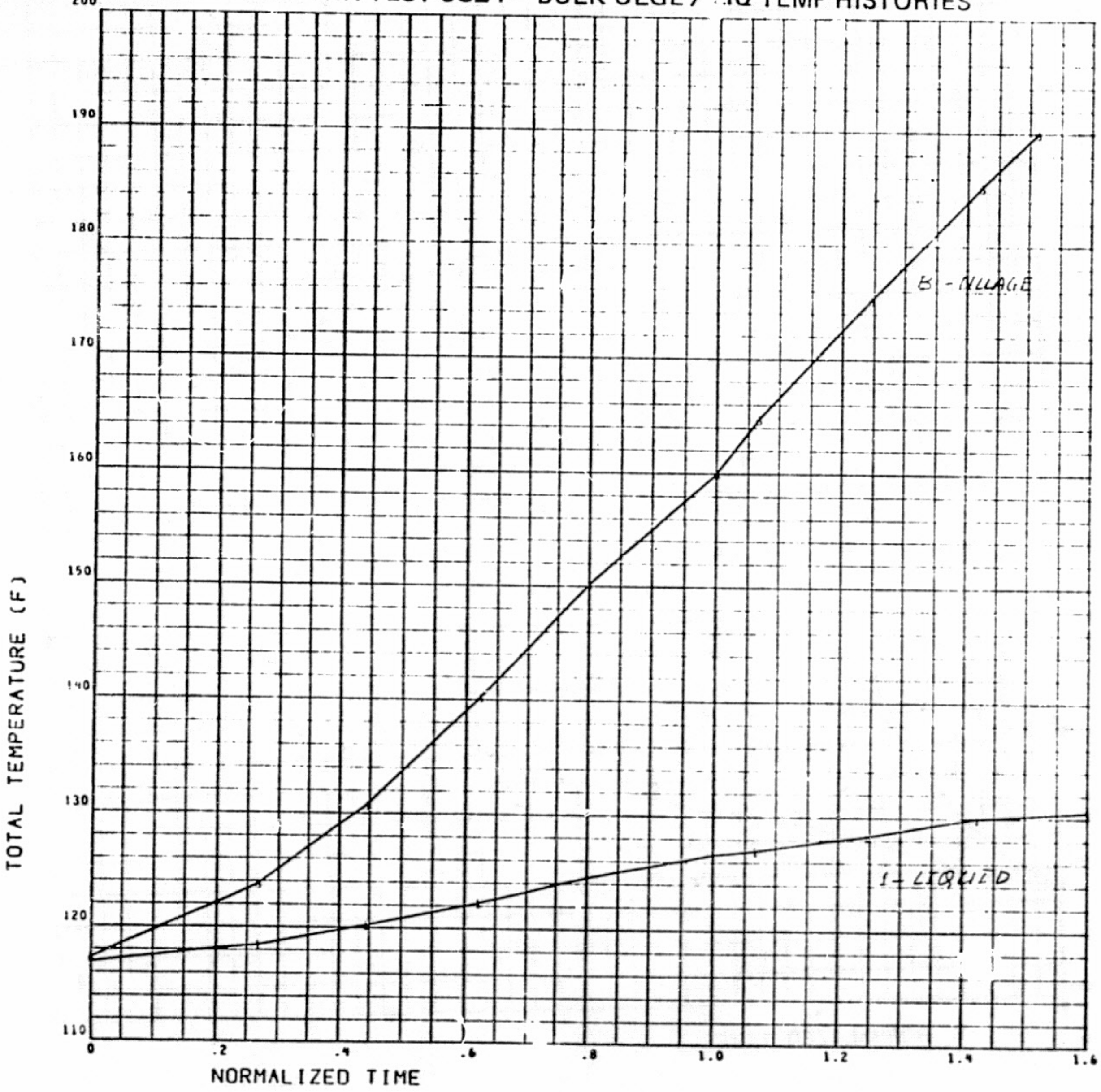


FIGURE 5.6-4b
6 IN. TNK TST8G6 BULK ULGE /LIQ TEMP HISTORIES

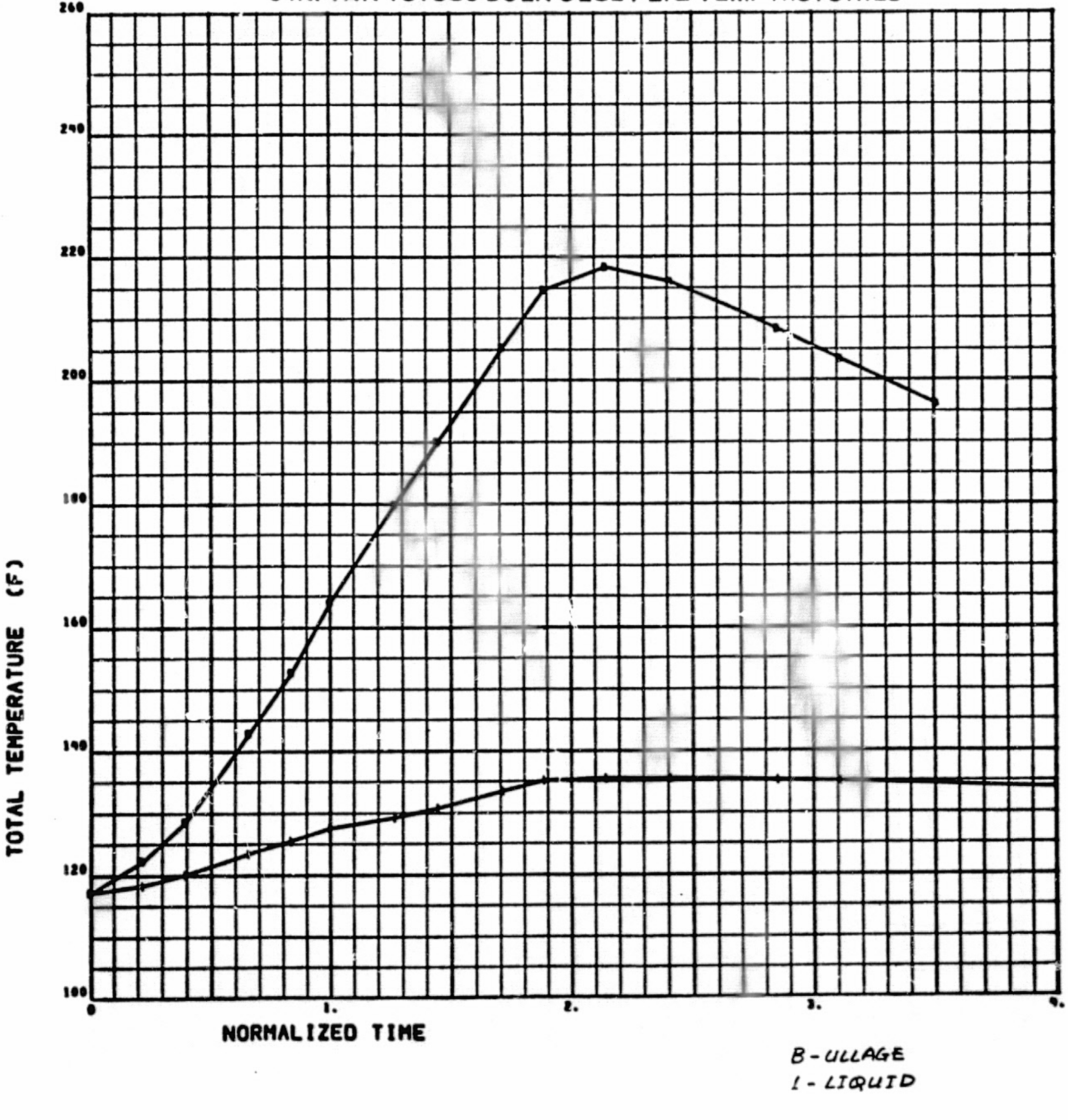


FIGURE 5.6-4c

12 IN. TNK TEST 1GΣ23 – BULK ULGE / LIQ TEMP HISTORIES

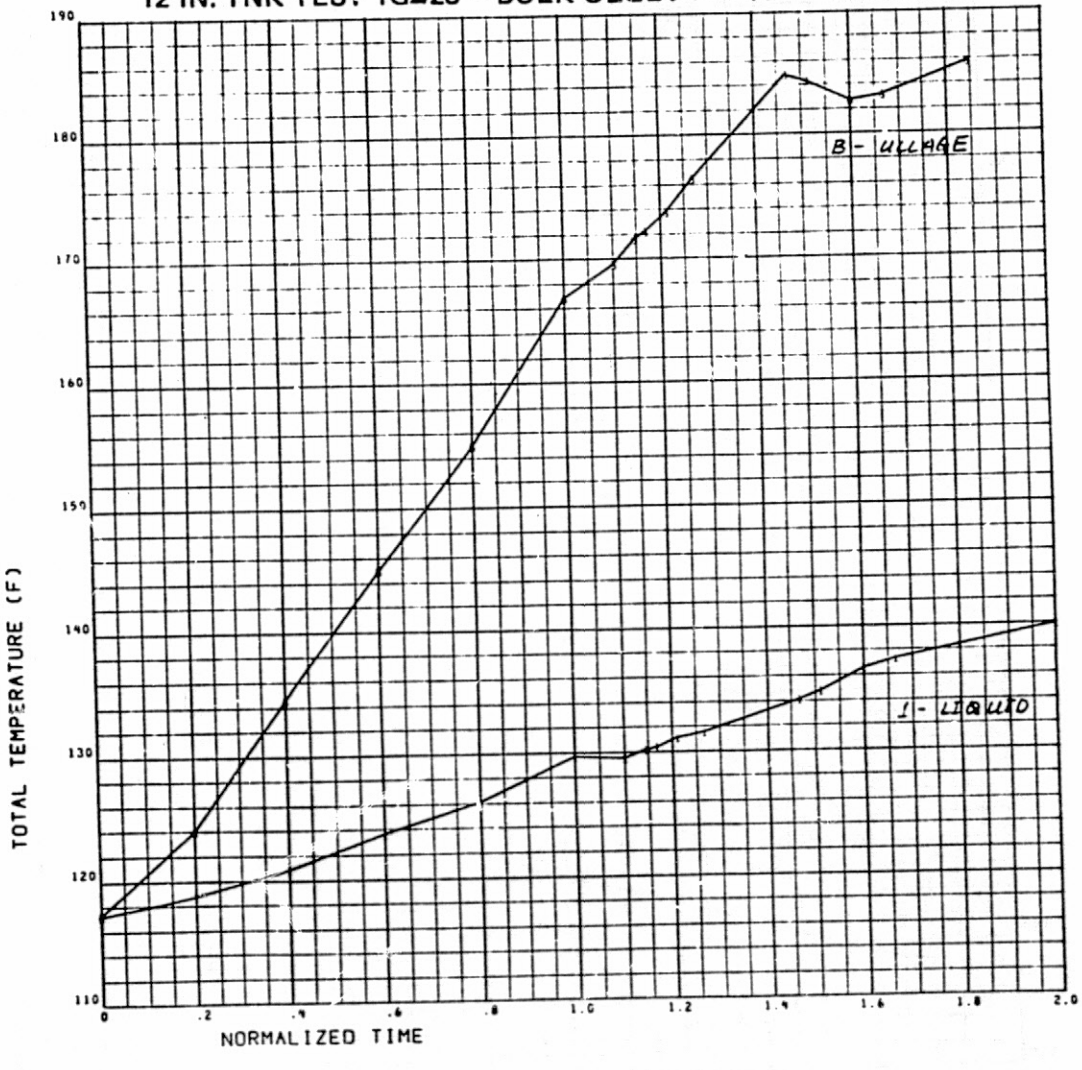


FIGURE 5.6-4d
12 IN. TNK TST1G28 BULK ULGE/LIQ TEMP HISTORIES

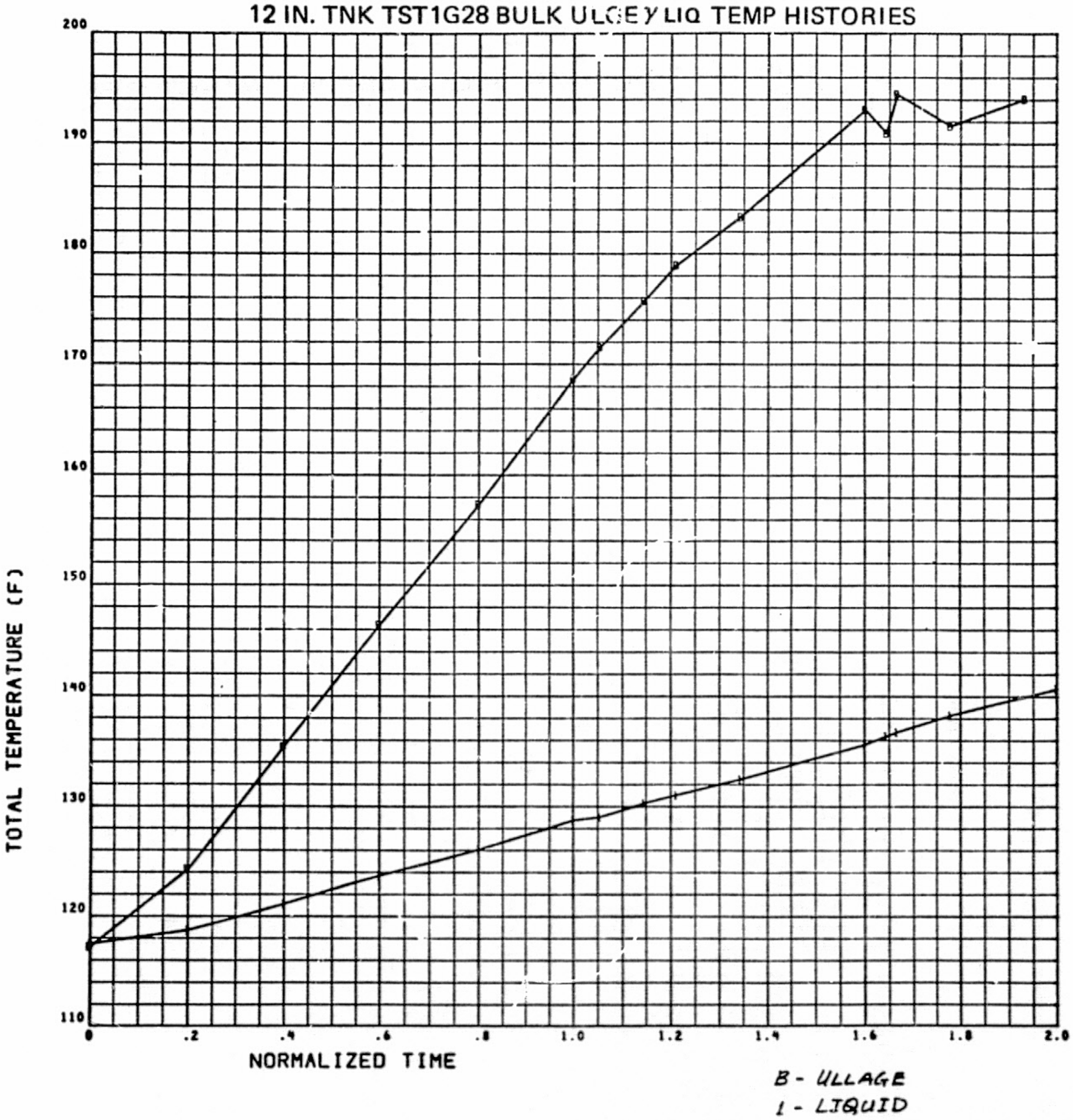
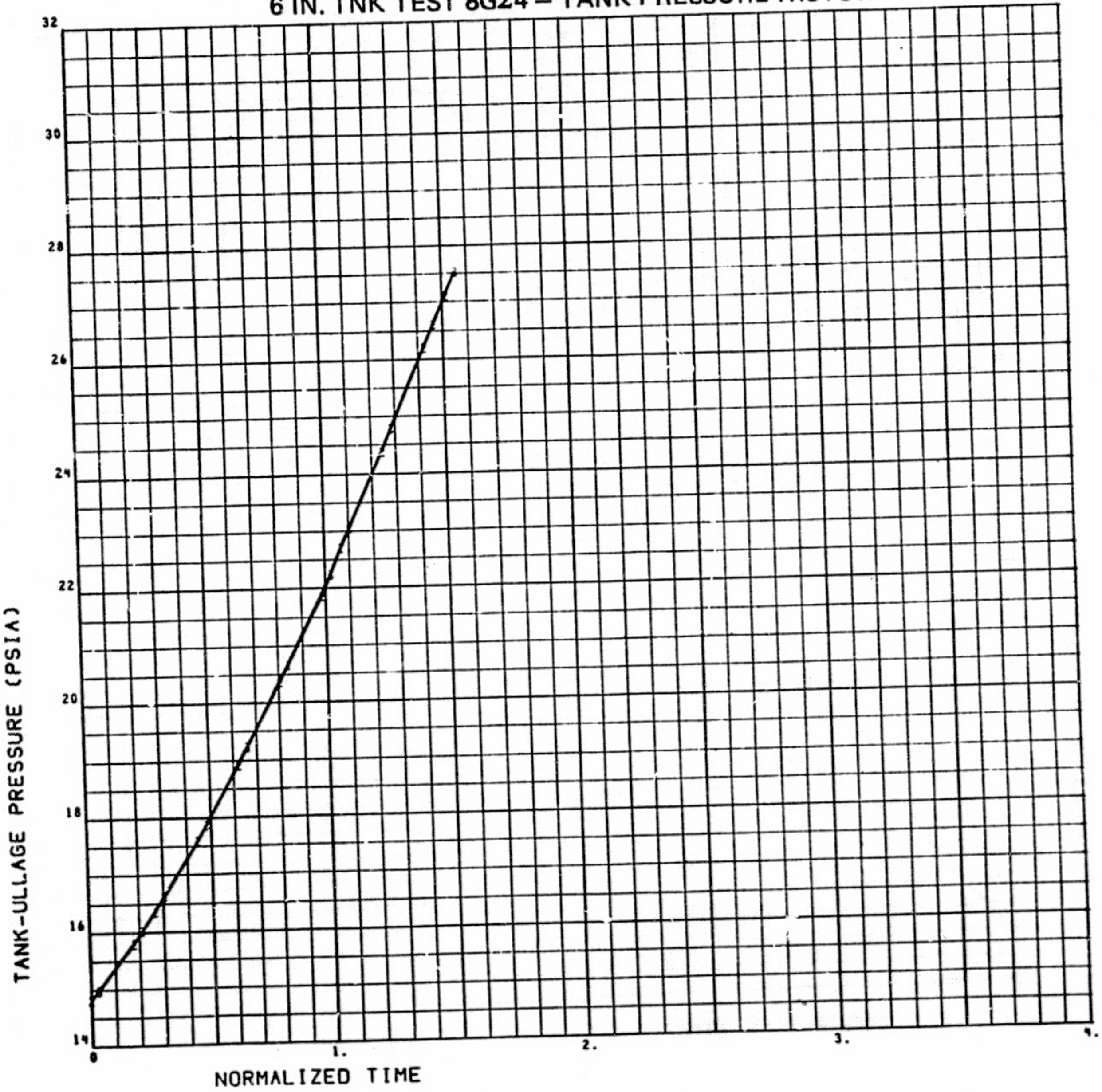


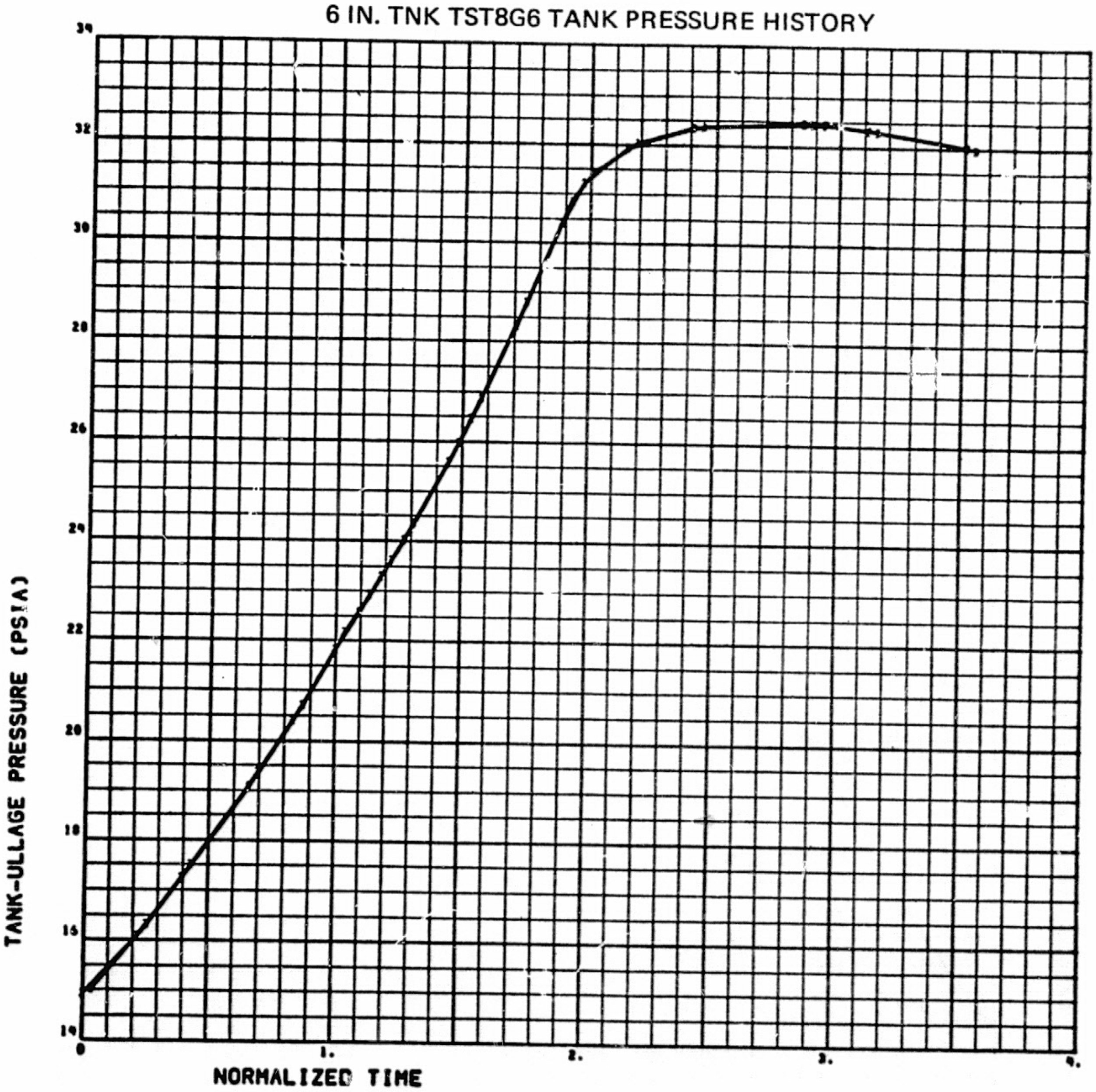
FIGURE 5.6-5a

6 IN. TNK TEST 8GΣ4 – TANK PRESSURE HISTORY



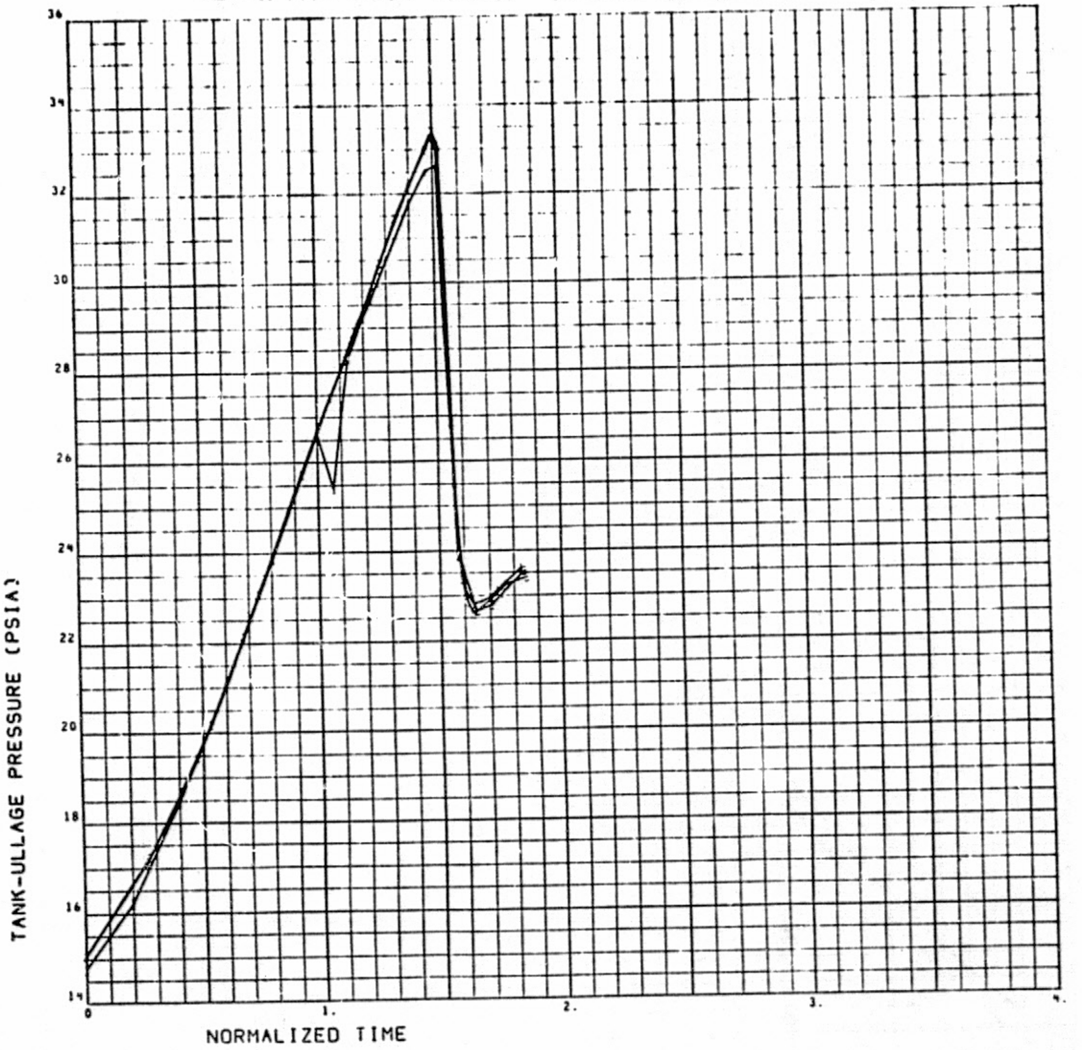
2)
3) - Transducer measured.

FIGURE 5.6-5b
6 IN. TNK TST8G6 TANK PRESSURE HISTORY



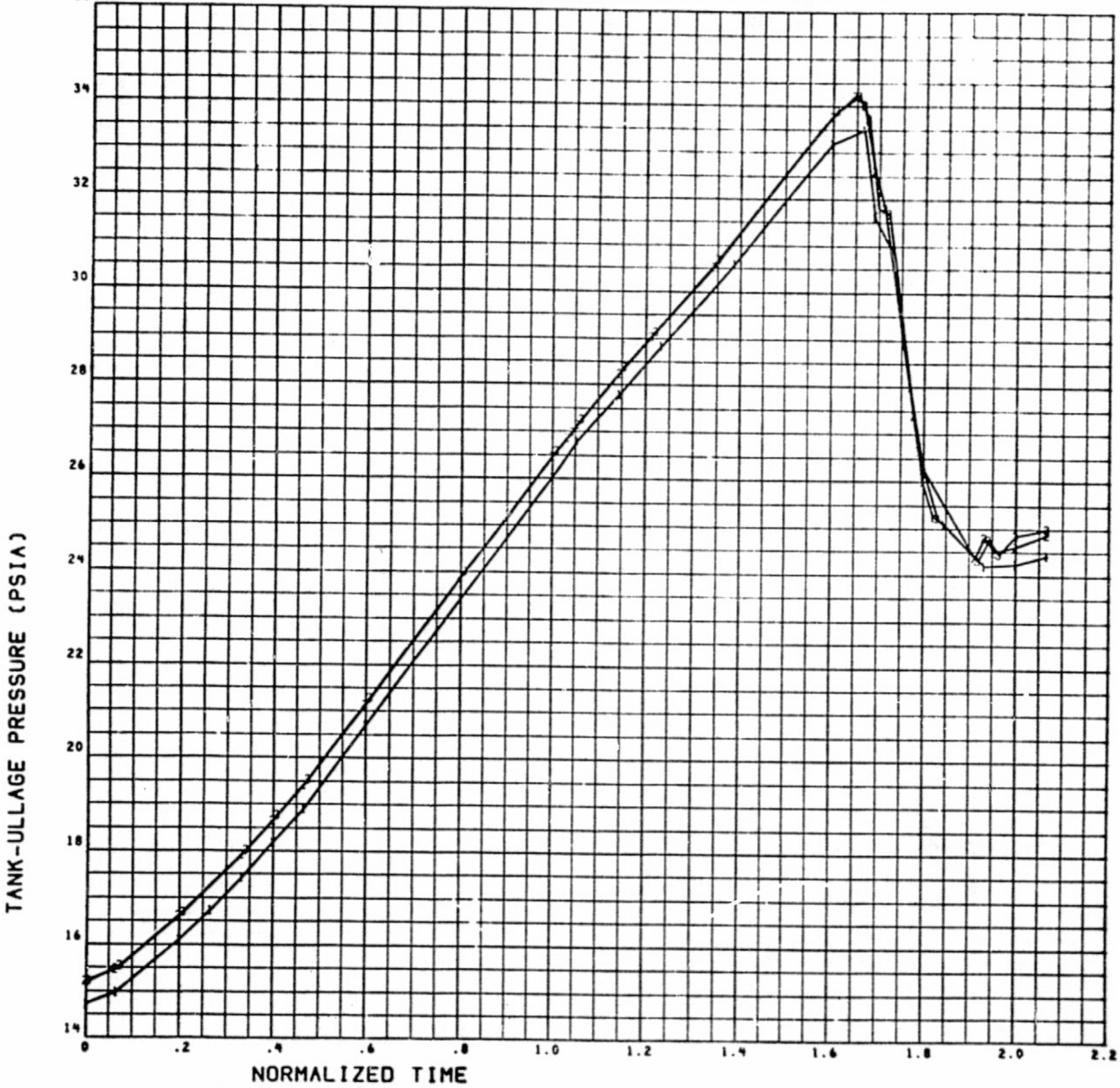
$^{2}_{3}$) Transducer Measured

FIGURE 5.6-5c
12 IN. TNK TEST 1GΣ23 – TANK PRESSURE HISTORY



1 – Gage measured
2 }
3 } - Transducer measured

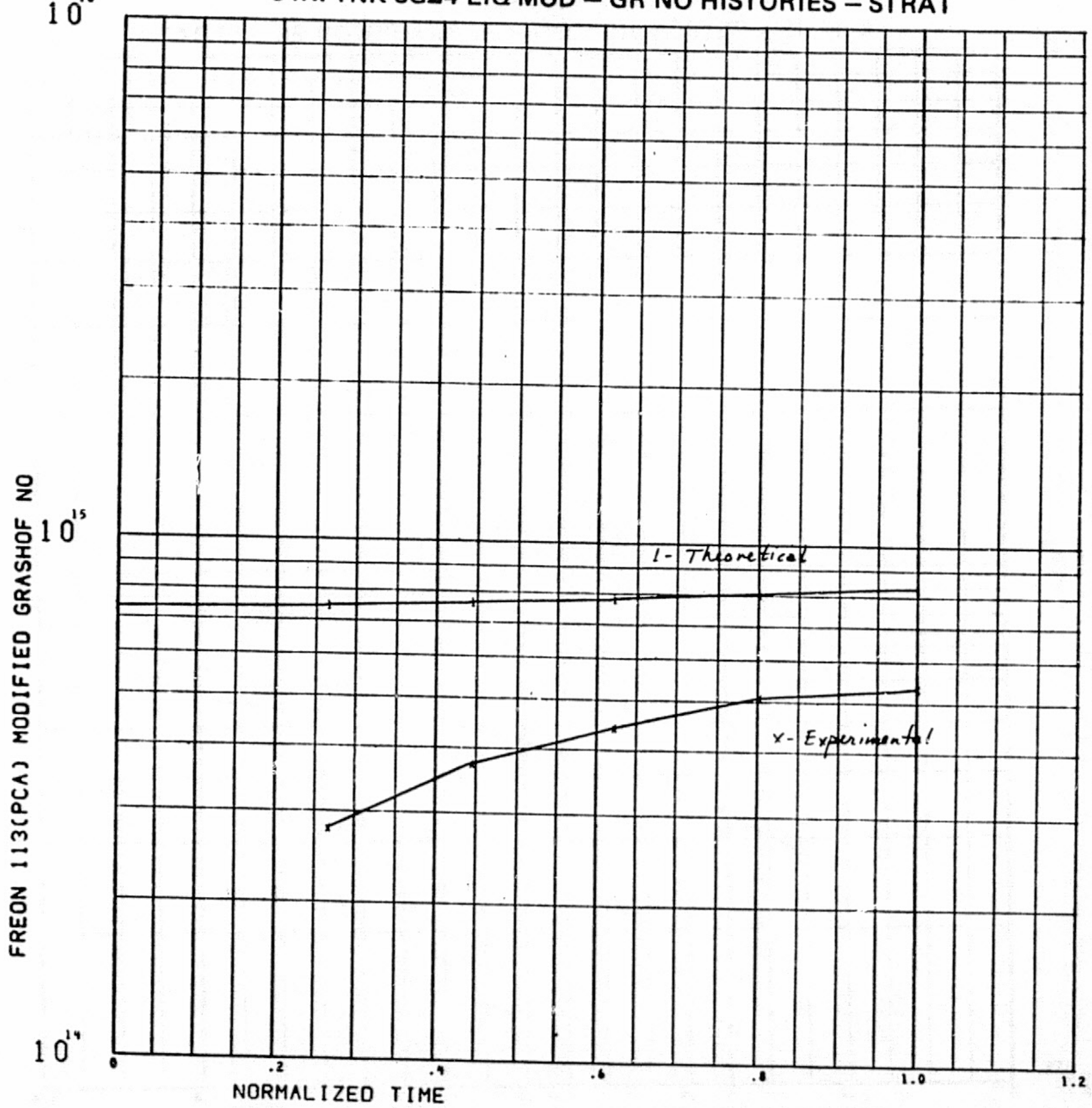
FIGURE 5.6-5d
12 IN. TNK TST1G28 TANK PRESSURE HISTORY



1 - Gage Measured
2, 3 - Transducer Measured

FIGURE 5.6-6a

6 IN. TNK 8GΣ4 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^{*} = \frac{g\beta L^{3}}{(\mu/\rho)^{2}}\left(\frac{q''L}{k}\right)$$

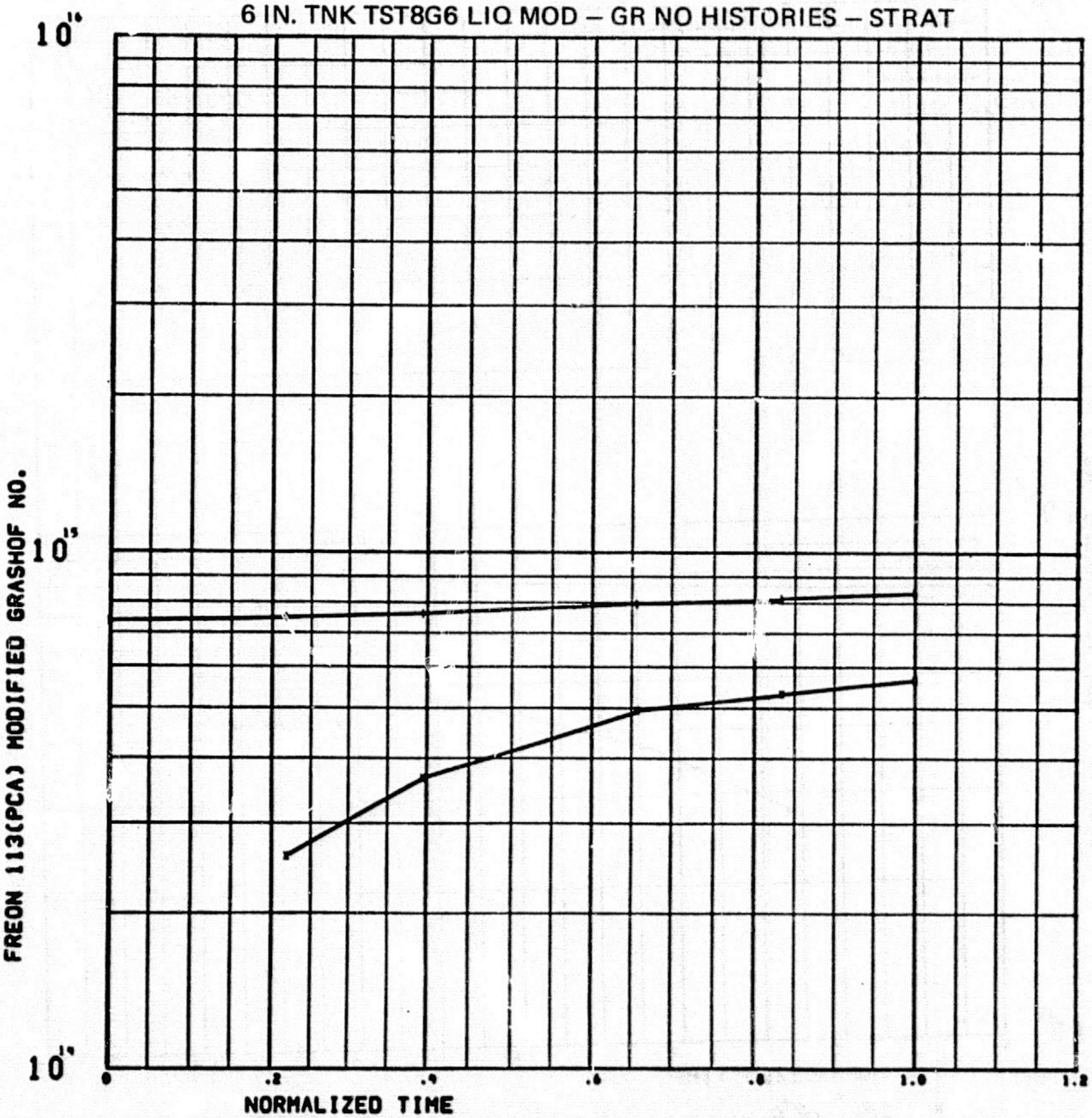
L = Fluid depth

I: Based on q'' wattage measured input

X: Based on experimentally determined q''_{Fluid}

FIGURE 5.6-6b

6 IN. TNK TST8G6 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''_H L}{k}\right)$$

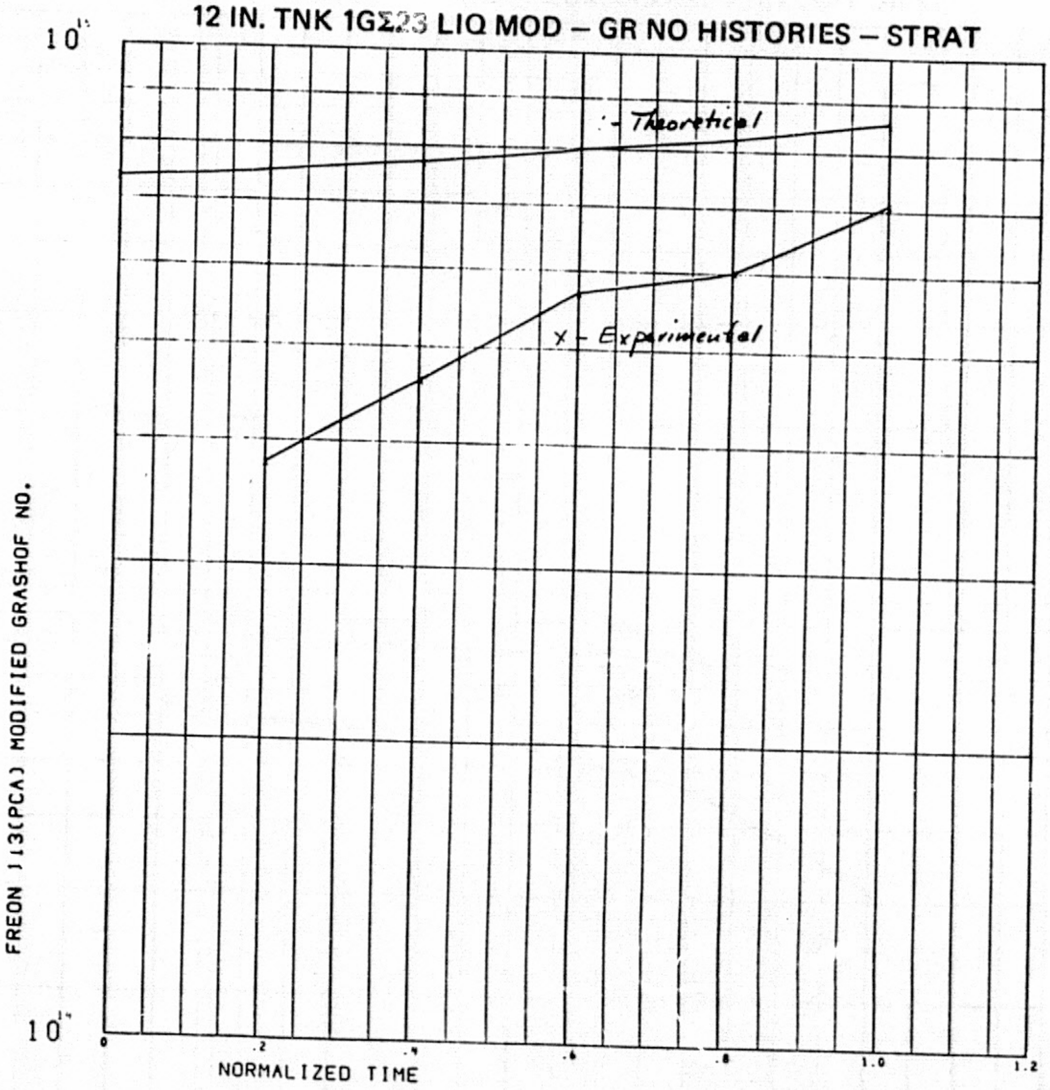
L = Fluid depth

I - Based on q''_H wattage measured input

x - Based on experimentally absorbed q''_{fluid}

FIGURE 5.6-6c

12 IN. TNK 1GΣ23 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{\dot{q}''L}{k}\right)$

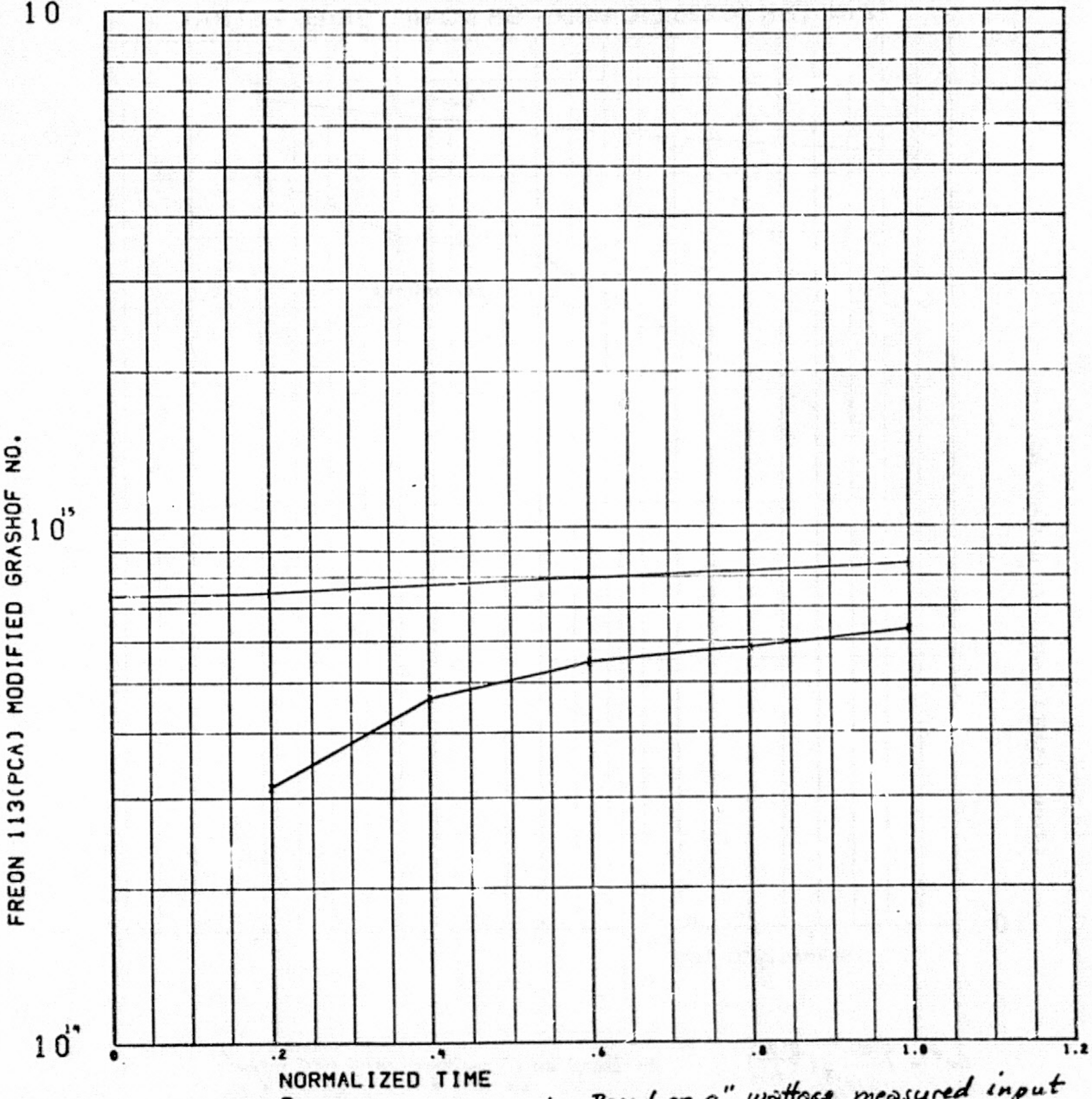
L = Fluid depth

: = Based on $\dot{q}''_{DH}$ wattage measured input

X = Based on experimentally determined $\dot{q}''_{Fluid(l)}$

FIGURE 5.6-6d

12 IN. TNK TST1G28 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr_i^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

L = Liquid depth

I - Based on q''_H wattage measured input

x - Based on experimentally absorbed $q''_{fluid(\ell)}$

FIGURE 5.6-7a

6 IN. TNK 8GΣ4 LIQ FOURIER NO HISTORY

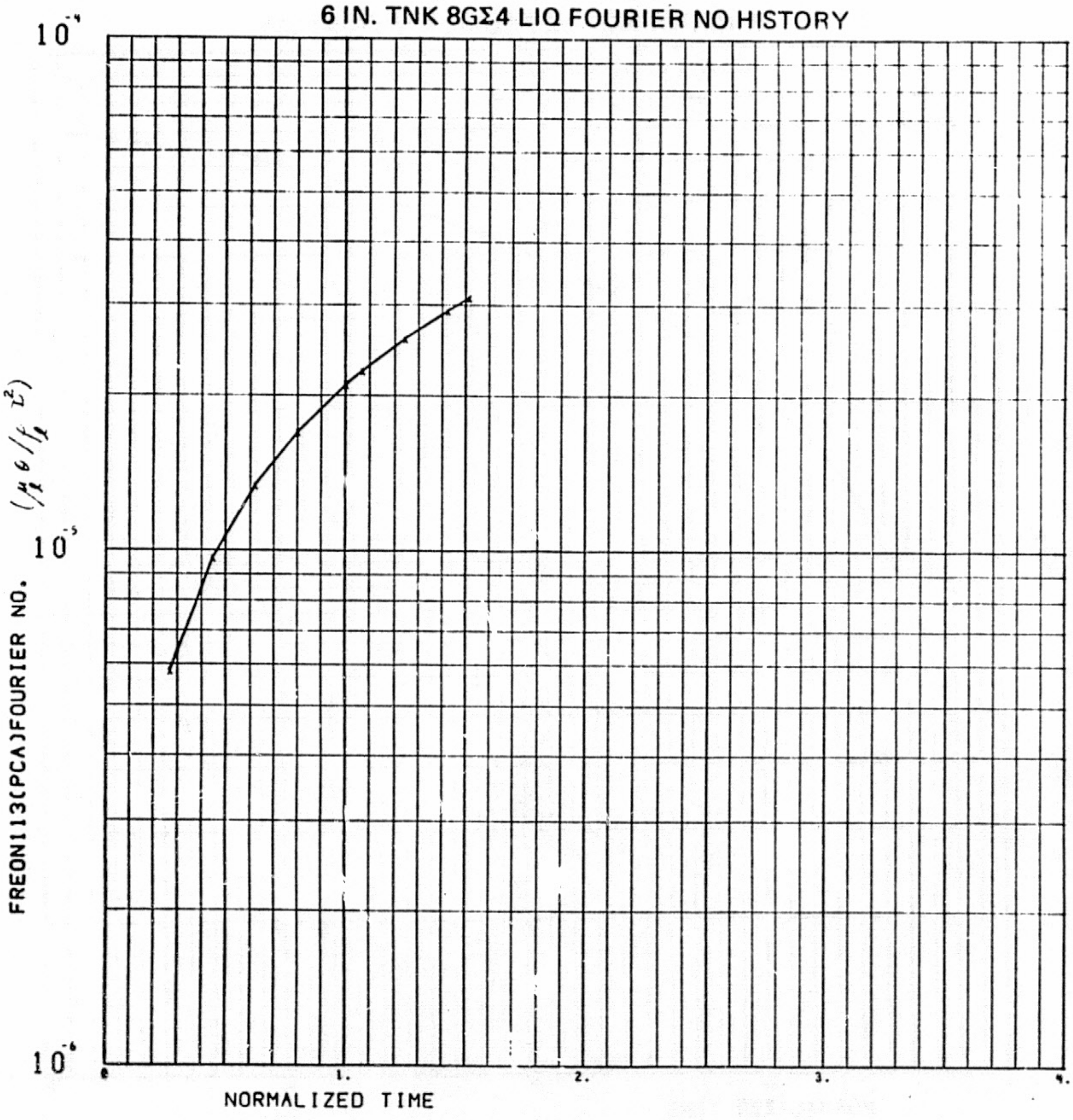
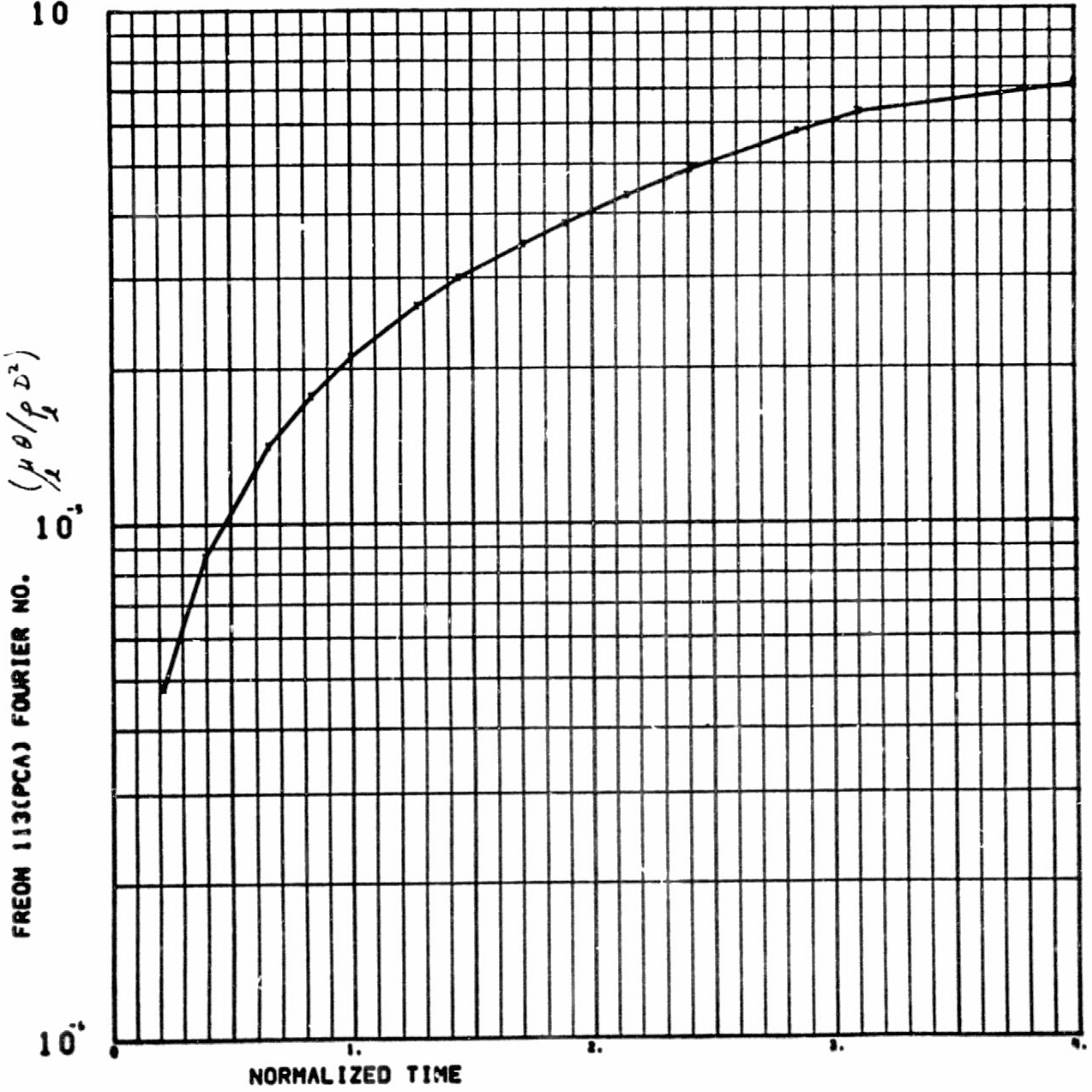


FIGURE 5.6-7b

6 IN. TNK 8G6 LIQ FOURIER NO HISTORY



C-4

FIGURE 5.6-7c

12 IN. TNK 1GΣ23 LIQ FOURIER NO HISTORY

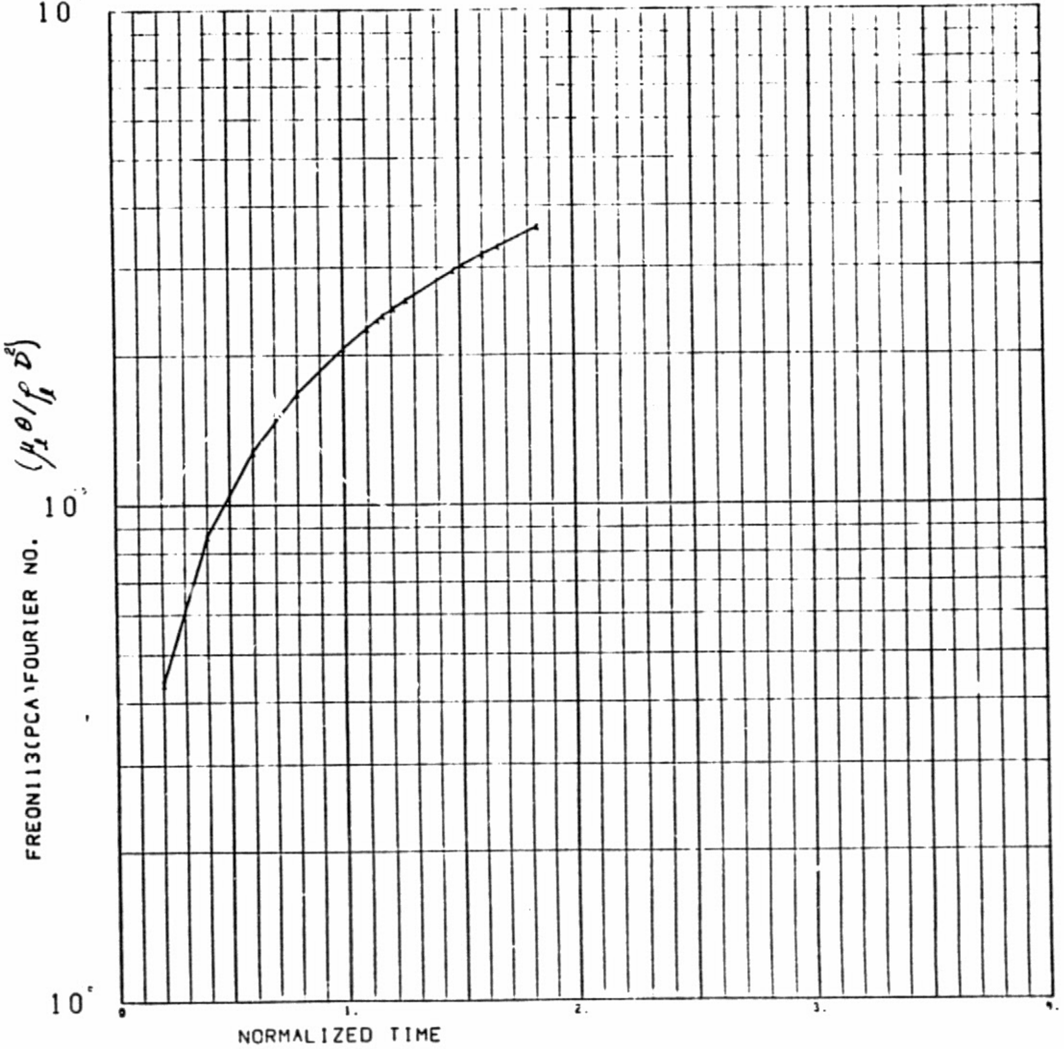
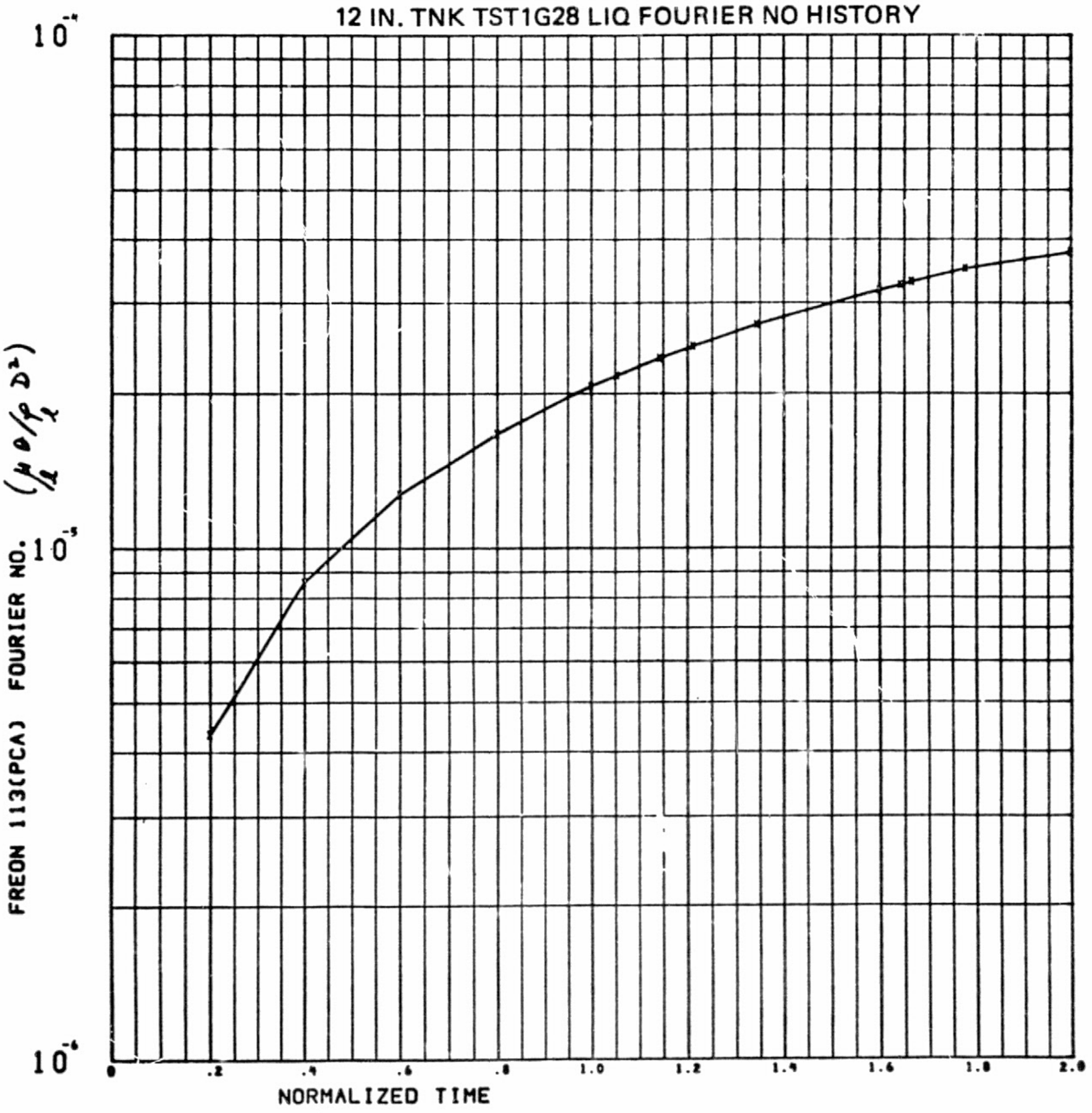


FIGURE 5.6-7d

12 IN. TNK TST1G28 LIQ FOURIER NO HISTORY



Section 5.7

SCALING SET

6-in. -Dia Tank Test	12-in. -Dia Tank Tests
8G	1G
Test #14	Test #26 Test #15

Table 5.7-1a. 6 IN. DIA. TANK TEST 8G#14 (Page 1 of 2)

```
       STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=    .3927       CYL AREA FT2=  1.5708        FLNGE AREA FT2=    .0365
DME WALL VOL FT3=    .00131      1/2 CYL WALL VOLFT3=    .00164      FLNGE VOL FT3=    .00076
DME MASS LBM=   .65596      MASS 1/2 CYL LBM=    .81996      FLANGE MASS=   .38058

 LIQ VOL FT3=   .22907       ULLAGE VOL FT3=    .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=  90,1273   H34=  90,1273   H56=  90,1273   H910=  90,1273   H78=   0,0000

EST,HT FLUX IN LIQ (BTU/HR-FT2)=  90,1273
EST,HT FLUX IN ULLGE (BTU/HR-FT2)=   0,0000
EST,HT INPUT LIQ(STRAT)BTU=   73,735      (STRAT+DESTRAT)BTU=   90,450
EST,LIQ TEMP INCRSE(STRAT)=   15,1332F      (STRAT+DESTRAT)=   18,5683F

EST,HT INPUT ULLAGE(STRAT)BTU=     0,000      (STRAT+DESTRAT)BTU=     0,000
```

Table 5.7-1b. 12 IN. DIA. TANK TEST 1G#26

```
      STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS


 DOME AREA FT2=  1,5708       CYL AREA FT2=  6,2832      FLNGE AREA FT2=   ,1458
DME WALL VOL FT3=   ,01047     1/2 CYL WALL VOLFT3=   ,01309     FLNGE VOL FT3=    ,00603
DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965     FLANGE MASS=  3,04465

 LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=   ,26180

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=  45,0637   H34=  45,0637   H56=  44,9334   H910=  45,0637   H78=   0,0000

EST,HT FLUX IN LIQ (BTU/HR-FT2)=  45,0116
EST,HT FLUX IN ULLGE (BTU/HR-FT2)=   0,0000
EST,HT INPUT LIQ(STRAT)BTU=  583,308      (STRAT+DESTRAT)BTU=  655,796
EST,LIQ TEMP INCRSE(STRAT)=   14,9611F      (STRAT+DESTRAT)=   17,0779F

EST,HT INPUT ULLAGE(STRAT)BTU=     0,000      (STRAT+DESTRAT)BTU=     0,000
```

Table 5.7-1c. 12 IN. DIA. TANK TEST #15 (Page 2 of 2)

```
------------STRUCTURAL GEOMETRIC--TANK--WTS-WATTMETER-HEAT-FLUX --INPUTS------------------------------

--DOME AREA FT2=  1.5708--------CYL AREA FT2= --6.2832------ FLNGE AREA FT2= ---.1458---------------
 DME WALL VOL FT3=    .01047      1/2 CYL WALL VOLFT3=    .01309      FLNGE VOL FT3=    .00608
 DME MASS LBM=  5.24772     MASS 1/2 CYL LBM=  6.55965     FLANGE MASS=  3.04465
-----------------------------------------------------------------------------------------------------
  LIQ VOL FT3=  1.83260       ULLAGE VOL FT3=    .26180

--INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES----------------------

 H12=  45.0637   H34=  45.0637   H56=  44.9334   H910=  45.0637   H78=   0.0000
-----------------------------------------------------------------------------------------------------
 EST.HT FLUX IN LIQ (BTU/HR-FT2)=  45.0116
 EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
-EST.HT INPUT LIQ(STRAT)BTU=  583.308----- (STRAT+DESTRAT)BTU= --765.960---------------------------
 EST.LIQ TEMP INCRSE(STRAT)=   14.9618F      (STRAT+DESTRAT)=   19.6470F

-EST.HT INPUT ULLAGE(STRAT)BTU= ----0.000----- (STRAT+DESTRAT)BTU= ----0.000------------------------
```

Table 5.7-2a. 6 IN. DIA TANK TEST 8G #14 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	5.000	10.000	15.000	20.000	25.000
TAU	0.000	.200	.400	.600	.800	1.000
1	117.208	122.208	125.083	127.708	130.292	132.417
2	117.417	124.250	127.042	129.667	132.250	134.375
3	117.708	123.833	126.542	129.083	131.667	133.833
4	117.875	123.542	126.083	128.583	130.958	133.125
5	117.208	122.333	124.542	127.000	129.208	131.333
6	117.208	122.000	123.958	126.125	128.375	130.375
7	117.354	121.750	123.479	125.333	127.354	129.104
8	117.500	121.500	123.000	124.542	126.333	127.833
9	116.125	118.208	119.583	120.792	122.542	124.000
10	117.333	122.542	125.542	128.292	130.750	133.083
11	117.417	122.333	124.792	127.292	129.792	132.083
12	117.833	121.500	123.750	126.042	128.250	130.500
13	117.083	120.667	121.917	123.417	125.167	126.542
14	116.000	120.583	123.250	125.708	128.083	130.208
15	116.667	122.750	125.583	128.083	130.667	132.833
16	117.250	122.708	125.042	127.542	129.917	131.958
17	116.688	121.313	123.229	125.146	127.250	128.917
18	116.125	119.917	121.417	122.750	124.583	125.875
19	115.583	117.833	119.083	120.333	121.917	123.250
20	117.333	122.542	125.542	128.292	130.750	133.083
21	117.417	122.333	124.792	127.292	129.792	132.083
22	117.833	121.500	123.750	126.042	128.250	130.500
23	117.083	120.667	121.917	123.417	125.167	126.542
24	116.500	120.083	122.792	125.250	127.833	129.958
25	116.292	119.958	122.583	125.125	127.667	129.833
26	116.229	119.833	122.500	124.958	127.500	129.646
27	116.167	119.708	122.417	124.792	127.333	129.458
28	116.500	120.000	122.583	125.250	127.708	129.917
29	116.167	119.375	122.083	124.667	127.250	129.417
30	116.417	120.083	122.833	125.250	127.792	130.083
31	116.333	120.354	121.313	122.708	124.333	125.729
32	116.750	120.875	121.708	123.250	124.875	126.375
33	115.333	117.792	118.583	119.750	121.125	122.458
34	113.125	114.083	114.542	115.000	116.167	117.042

Table 5.7-2a. 6 IN. DIA TANK TEST 8G #14 (Page 2 of 2)

35	109.958	109.667	109.167	109.167	109.792	110.417
36	115.917	119.833	120.917	122.167	123.792	125.083
37	116.583	120.208	122.958	125.500	128.000	130.250
38	116.583	120.292	123.000	125.375	128.000	130.333
39	116.792	120.458	123.292	125.792	128.250	130.542
40	117.083	120.750	123.583	125.958	128.542	130.792
41	117.458	120.583	123.500	126.083	128.625	130.792
42	117.542	120.917	123.625	126.125	128.708	131.083
43	117.792	120.875	123.708	126.125	128.750	131.042
44	117.917	121.250	124.000	126.458	129.167	131.375
45	117.708	120.750	123.583	126.250	128.750	131.042
46	117.625	121.292	124.042	126.708	129.208	131.500
47	118.083	121.417	123.792	126.333	128.792	131.167
48	117.125	119.750	122.354	124.896	127.313	129.542
49	116.792	118.917	121.208	123.708	126.000	128.292
50	117.250	119.083	121.500	123.917	126.292	128.583
51	117.125	118.833	121.042	123.500	125.667	127.875
52	117.875	119.521	121.833	124.167	126.479	128.729
53	116.708	118.000	120.542	122.833	125.208	127.542
54	118.625	120.208	122.625	124.833	127.292	129.583
55	118.500	120.000	122.500	125.000	127.208	129.583
56	118.625	120.208	122.625	124.833	127.292	129.583
57	118.500	120.000	122.500	125.000	127.208	129.583
58	117.042	118.167	120.583	122.833	125.125	127.458
59	118.208	119.542	121.708	124.083	126.250	128.583
60	119.583	120.792	123.083	125.250	127.458	129.917
61	116.458	117.083	118.875	121.042	123.167	125.333
62	116.417	116.792	118.583	120.542	122.500	124.750
63	117.750	118.292	120.083	122.125	124.167	126.333
64	118.875	119.333	121.208	123.167	125.208	127.208
65	116.292	116.208	117.583	119.458	121.250	123.250
66	116.625	116.250	117.458	118.958	120.708	122.292
67	117.292	117.458	118.333	120.000	121.917	123.333
68	116.333	116.167	117.250	118.646	120.250	121.750
69	115.958	115.792	116.667	118.167	119.708	121.083
70	116.042	116.083	117.042	118.333	119.792	121.208
71	116.667	117.083	117.875	119.125	120.542	122.000
72	117.417	118.333	119.333	120.583	122.042	123.458
73	115.208	116.042	116.708	117.958	119.458	120.792
74	109.458	112.500	115.292	117.750	120.083	122.208
75	96.667	99.458	101.833	103.708	105.292	106.917
76	105.375	106.167	107.250	108.542	109.750	111.167
77	91.083	90.375	90.417	90.875	91.458	92.083

Table 5.7-2b. 12 IN. DIA TANK TEST 1G #26 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	21,000	41,000	61,000	81,000	99,000
TAU	0,000	,212	,414	,616	,818	1,000
1	116,983	120,400	123,000	125,542	127,792	129,875
2	117,150	121,383	123,667	126,250	128,625	130,625
3	117,546	121,663	124,000	126,500	128,875	130,833
4	117,721	121,613	123,917	126,458	128,708	130,792
5	117,504	121,392	123,708	126,125	128,417	130,458
6	117,454	120,825	122,875	125,292	127,458	129,333
▼ 7	117,554	120,729	122,667	124,958	127,042	128,875
8	117,775	120,629	122,333	124,292	126,292	128,000
9	117,846	119,408	120,917	122,875	124,667	126,333
10	117,375	122,446	124,750	127,333	129,625	131,708
11	117,579	122,363	124,542	127,125	129,417	131,458
12	117,675	122,050	124,208	126,542	128,750	130,750
13	117,603	121,438	123,000	125,083	127,000	128,833
14	116,500	120,542	122,792	125,333	127,708	129,667
15	117,250	122,421	124,750	127,292	129,750	131,708
16	117,546	122,229	124,458	127,000	129,250	131,333
17	117,371	121,758	123,750	126,208	128,375	130,375
18	117,308	120,900	122,500	124,542	126,500	128,250
19	117,358	118,975	120,458	122,292	124,167	125,833
20	117,867	122,646	124,917	127,500	129,792	131,833
21	117,817	122,313	124,583	127,042	129,375	131,333
22	117,700	121,833	123,792	126,250	128,500	130,417
23	117,854	121,342	122,958	125,000	127,000	128,708
24	116,306	119,688	121,583	123,917	126,000	128,042
25	115,871	118,742	119,833	121,333	122,958	124,625
26	115,671	117,125	115,375	114,917	115,458	116,375
27	115,675	114,458	109,875	107,958	107,667	107,875
28	115,913	118,892	120,458	122,375	124,333	126,042
29	115,729	118,746	120,375	122,375	124,375	126,167
30	116,192	119,458	121,417	123,667	125,792	127,750
31	118,100	120,071	122,542	124,417	126,250	127,875
32	117,871	120,650	122,125	124,042	125,750	127,375
33	115,546	116,813	117,292	118,125	119,125	120,000
34	114,596	111,775	110,208	109,375	108,958	108,917

Table 5.7-2b. 12 IN. DIA TANK TEST 1G #26 (Page 2 of 2)

35	114,046	108,721	105,542	103,458	103,529	101,125
36	116,308	121,171	122,833	124,708	126,583	128,250
37	116,271	119,142	120,875	122,833	124,917	126,750
38	116,417	119,367	121,292	123,417	125,417	127,375
39	116,667	119,738	121,875	124,083	126,375	128,250
40	116,904	120,192	122,583	124,917	127,375	129,417
41	117,517	120,079	122,458	125,000	127,292	129,375
42	117,592	120,229	122,583	125,083	127,542	129,542
43	117,717	120,333	122,708	125,167	127,625	129,625
44	117,688	120,417	122,875	125,292	127,708	129,708
45	117,717	120,179	122,583	125,083	127,500	129,500
46	117,567	120,542	122,875	125,333	127,833	129,750
47	117,817	120,517	122,833	125,333	127,750	129,750
48	118,025	120,592	123,000	125,417	127,792	129,917
49	117,929	120,375	122,708	125,167	127,542	129,667
50	117,833	120,158	122,458	124,958	127,333	129,417
51	117,825	120,004	122,292	124,875	127,167	129,000
52	117,800	120,158	122,542	125,000	127,292	129,125
53	117,713	120,204	122,500	124,958	127,167	129,042
54	117,896	120,325	122,625	125,083	127,333	129,292
55	117,788	120,175	122,458	125,000	127,167	129,125
56	117,796	120,200	122,458	125,125	127,292	129,208
57	117,750	120,179	122,500	125,042	127,167	129,083
58	117,850	120,200	122,500	125,000	127,167	120,083
59	117,629	119,988	122,167	124,708	126,833	128,750
60	117,521	119,796	122,042	124,500	126,625	128,500
61	117,567	119,721	121,792	124,333	126,417	128,375
62	117,733	119,758	121,833	124,167	126,292	128,167
63	117,496	119,525	121,583	123,917	126,042	127,917
64	117,392	119,246	121,083	123,333	125,375	127,125
65	117,467	119,333	121,208	123,500	125,417	127,167
66	117,467	119,333	121,208	123,500	125,417	127,167
67	117,392	119,017	120,750	122,750	124,583	126,250
68	117,350	118,842	120,375	122,417	124,042	125,625
69	117,458	118,929	120,500	122,458	124,208	125,708
70	117,458	118,929	120,417	122,333	124,208	125,708
71	117,350	118,754	120,333	122,250	123,958	125,500
72	117,379	118,771	120,292	122,292	123,958	125,458
▼73	117,429	118,813	120,375	122,292	123,958	125,458
74	94,004	95,333	96,500	98,000	99,125	100,083
75	104,529	106,533	108,208	110,333	111,958	113,292
76	83,867	84,829	85,417	86,333	86,875	87,417
77	94,233	95,638	96,792	98,292	99,375	100,458

Table 5.7-2c. 12 IN. DIA TANK TEST 1G #15 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

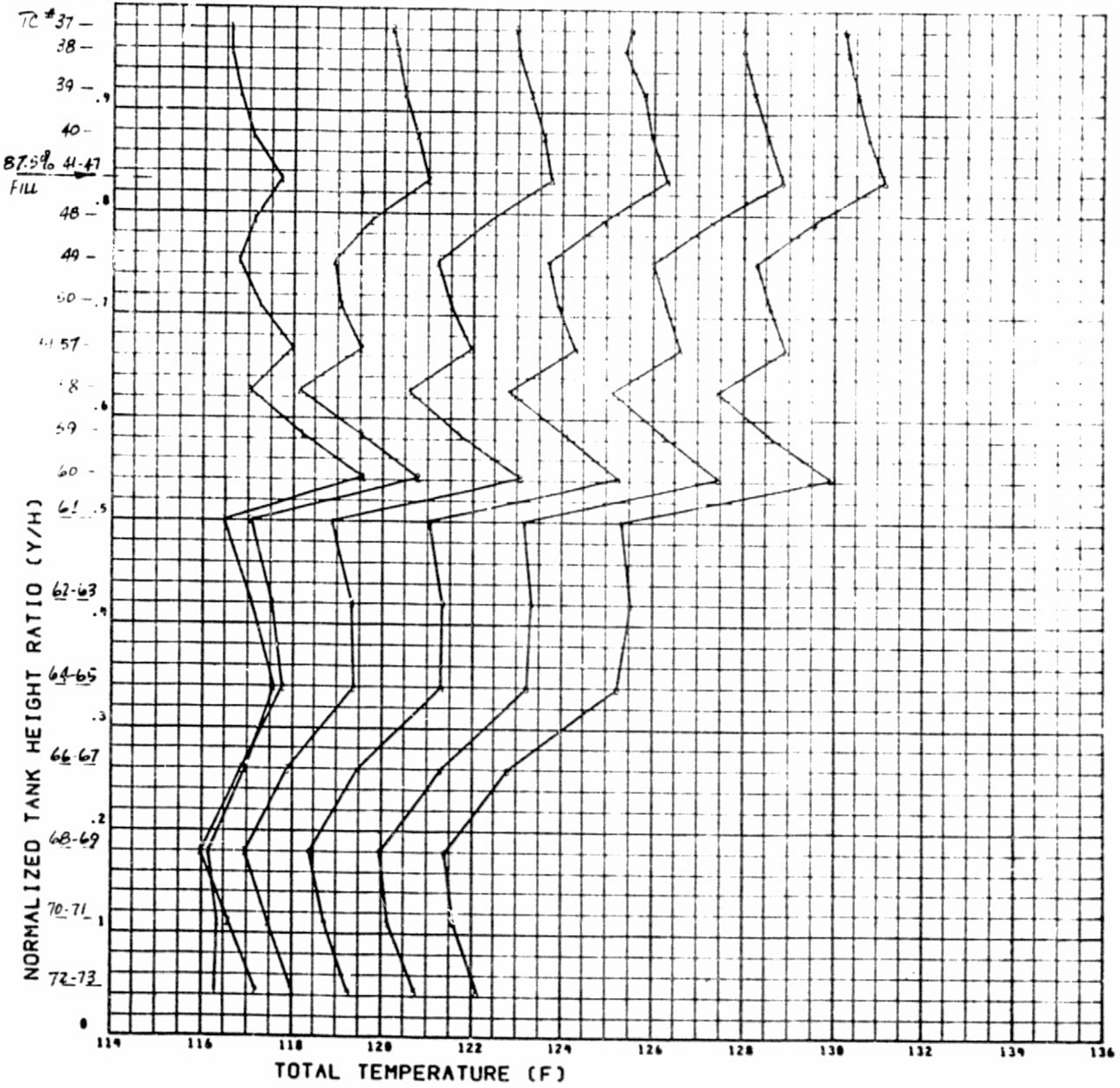
TIME(MIN)	0.000	21.000	41.000	61.000	81.000	99.000
TAU	0.000	.212	.414	.616	.818	1.000
1	117.042	120.583	122.958	125.250	127.375	129.417
2	117.250	121.500	123.958	126.083	128.333	130.208
3	117.958	121.750	124.167	126.417	128.542	130.500
4	118.250	121.708	124.083	126.167	128.417	130.375
5	117.958	121.500	123.792	125.958	128.125	130.000
6	117.625	120.958	123.167	125.250	127.250	129.167
7	117.708	120.792	122.792	124.792	126.708	128.500
8	117.667	120.625	122.375	124.167	125.875	127.583
9	117.000	119.292	120.917	122.542	124.167	125.667
10	117.583	122.417	124.833	127.042	129.208	131.167
11	118.000	122.542	124.958	127.167	129.333	131.292
12	117.792	122.083	124.250	126.417	128.458	130.333
13	117.417	121.375	123.125	124.792	126.625	128.375
14	116.708	120.542	122.958	125.208	127.417	129.333
15	117.583	122.625	125.083	127.333	129.542	131.417
16	118.167	121.958	124.292	126.625	128.750	130.708
17	117.500	121.625	123.750	125.875	127.958	129.875
18	117.292	120.667	122.458	124.292	126.000	127.667
19	116.542	118.792	120.375	122.125	123.708	125.250
20	117.583	122.583	125.000	127.250	129.375	131.375
21	117.917	122.500	124.792	127.042	129.208	131.167
22	117.458	121.792	123.958	126.083	128.125	130.083
23	117.417	121.125	122.917	124.750	126.583	128.250
24	116.875	119.875	122.208	124.417	126.542	128.500
25	116.458	119.375	121.542	123.500	125.458	127.208
26	116.208	118.875	120.000	119.208	119.250	119.958
27	116.125	117.958	114.042	110.625	109.500	109.583
28	116.875	119.458	121.708	123.875	125.958	127.833
29	116.750	119.208	121.458	123.667	125.708	127.708
30	116.667	119.667	122.000	124.250	126.333	128.333
31	117.250	120.792	122.417	124.125	125.750	127.167
32	117.083	120.417	121.917	123.500	124.958	126.375
33	114.917	115.500	115.875	116.542	117.417	118.417
34	114.708	110.458	108.667	108.042	108.000	108.292

Table 5.7-2c. 12 IN. DIA TANK TEST 1G #15 (Page 2 of 2)

35	114.542	107.542	103.958	101.875	100.958	100.708
36	117.500	121.125	122.708	124.458	126.083	127.625
37	117.042	119.625	121.875	124.083	126.208	128.042
38	116.833	119.708	122.000	124.250	126.292	128.167
39	117.000	119.917	122.333	124.583	126.667	128.583
40	117.708	120.375	122.792	125.042	127.250	129.167
41	117.458	120.208	122.500	124.792	127.083	129.042
42	117.625	120.333	122.792	125.125	127.250	129.167
43	117.792	120.417	122.750	125.167	127.292	129.250
44	118.000	120.458	122.917	125.208	127.375	129.292
45	117.667	120.292	122.708	125.000	127.208	129.083
46	117.583	120.542	122.917	125.250	127.458	129.417
47	117.792	120.583	122.875	125.167	127.417	129.375
48	118.083	120.667	123.042	125.375	127.500	129.458
49	117.958	120.458	122.854	125.146	127.313	129.250
50	117.833	120.250	122.667	124.917	127.125	129.042
51	117.667	119.875	122.333	124.458	126.625	128.708
52	117.750	119.917	122.500	124.667	126.792	128.875
53	117.583	119.958	122.542	124.458	126.667	128.708
54	117.792	120.167	122.583	124.833	126.917	128.958
55	117.708	120.042	122.542	124.542	126.708	128.375
56	117.750	120.042	122.583	124.667	126.875	128.875
57	117.667	120.042	122.500	124.542	126.708	128.792
58	117.792	120.000	122.583	124.667	126.667	128.875
59	117.667	119.708	122.208	124.250	126.458	128.542
60	117.542	119.667	122.083	124.000	126.167	128.250
61	117.583	119.500	121.875	123.875	126.042	128.083
62	117.750	119.458	121.792	123.708	125.750	127.833
63	117.458	119.250	121.625	123.458	125.583	127.625
64	117.542	119.000	121.167	122.833	124.917	126.875
65	117.500	119.042	121.208	122.958	125.000	127.000
66	117.500	118.736	120.736	122.278	124.139	126.000
67	117.500	118.708	120.667	122.250	124.083	126.000
68	117.458	118.500	120.375	121.750	123.417	125.125
69	117.500	118.583	120.333	121.792	123.500	125.333
70	117.625	118.583	120.417	121.917	123.500	125.167
71	117.292	118.417	120.250	121.625	123.333	125.042
72	117.375	118.333	120.167	121.583	123.250	125.000
73	117.458	118.458	120.167	121.625	123.250	125.042
74	92.875	92.583	93.417	94.250	95.167	96.292
75	104.542	105.208	106.958	108.292	109.917	111.583
76	84.000	83.917	84.250	84.208	84.625	85.208
77	96.917	96.792	97.250	97.583	98.333	99.458

FIGURE 5.7-1a

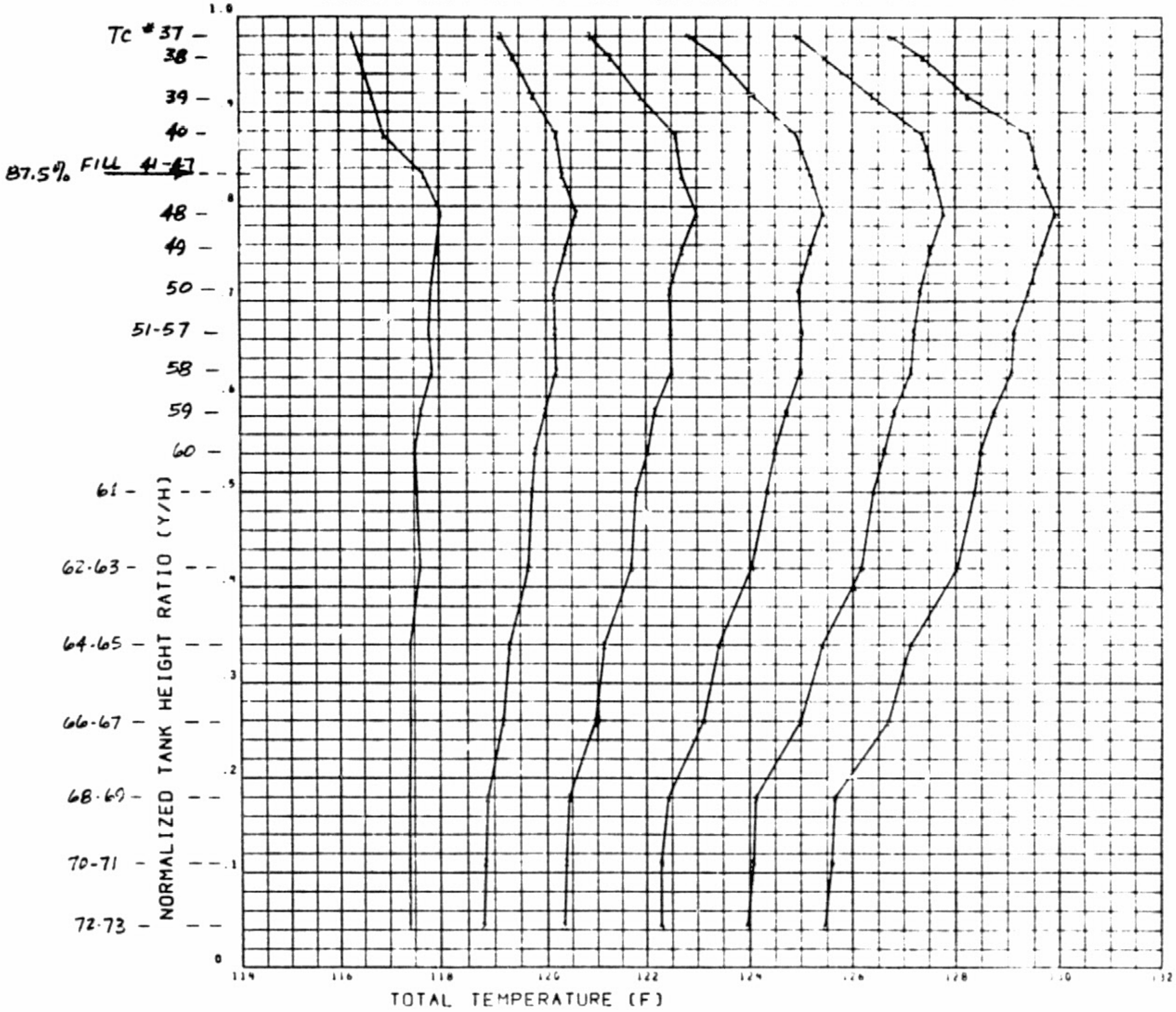
6 IN. TNK TEST 8GΣ14 – STRAT TEMPERATURE PROFILE



$q''_H = 90$ BTU/hr ft^2 LIQ HT'G ONLY

	T (min)	τ (TAU)
1	0.	0.
2	5.	.2
3	10.	.4
4	15.	.6
5	20.	.8
6	25.	1.0

FIGURE 5.7-1b
12 IN. TNK TEST 1GΣ26 – START TEMPERATURE PROFILE

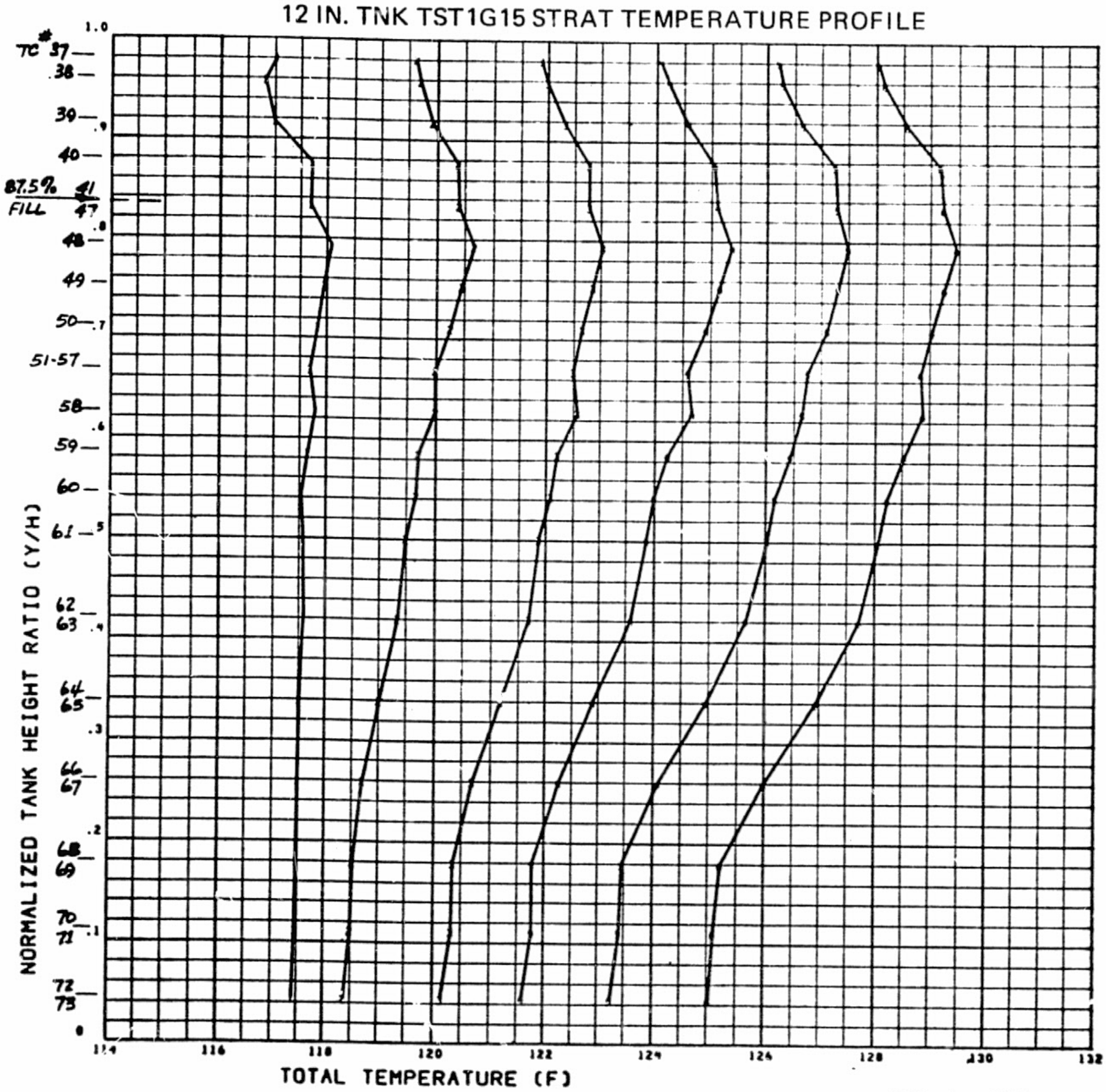


$q''_H = 45$ BTU/hr ft²

LIQ HTG ONLY

	T (min)	τ (TAU)
1	0.	0.
2	21.	.212
3	41.	.414
4	61.	.616
5	81.	.818
6	99.	1.0

FIGURE 5.7-1c
12 IN. TNK TST1G15 STRAT TEMPERATURE PROFILE



q''_{OH} = 45 BTU/hr ft² LIQ HTG

	T(min)	τ(TAU)
1	0.	0.
2	21.	.212
3	41.	.414
4	61.	.616
5	81.	.818
6	99.	1.000

]

FIGURE 5.7-2a

6 IN. TNK TEST 8GΣ14 – STRAT DEL – TEMP PROFILE

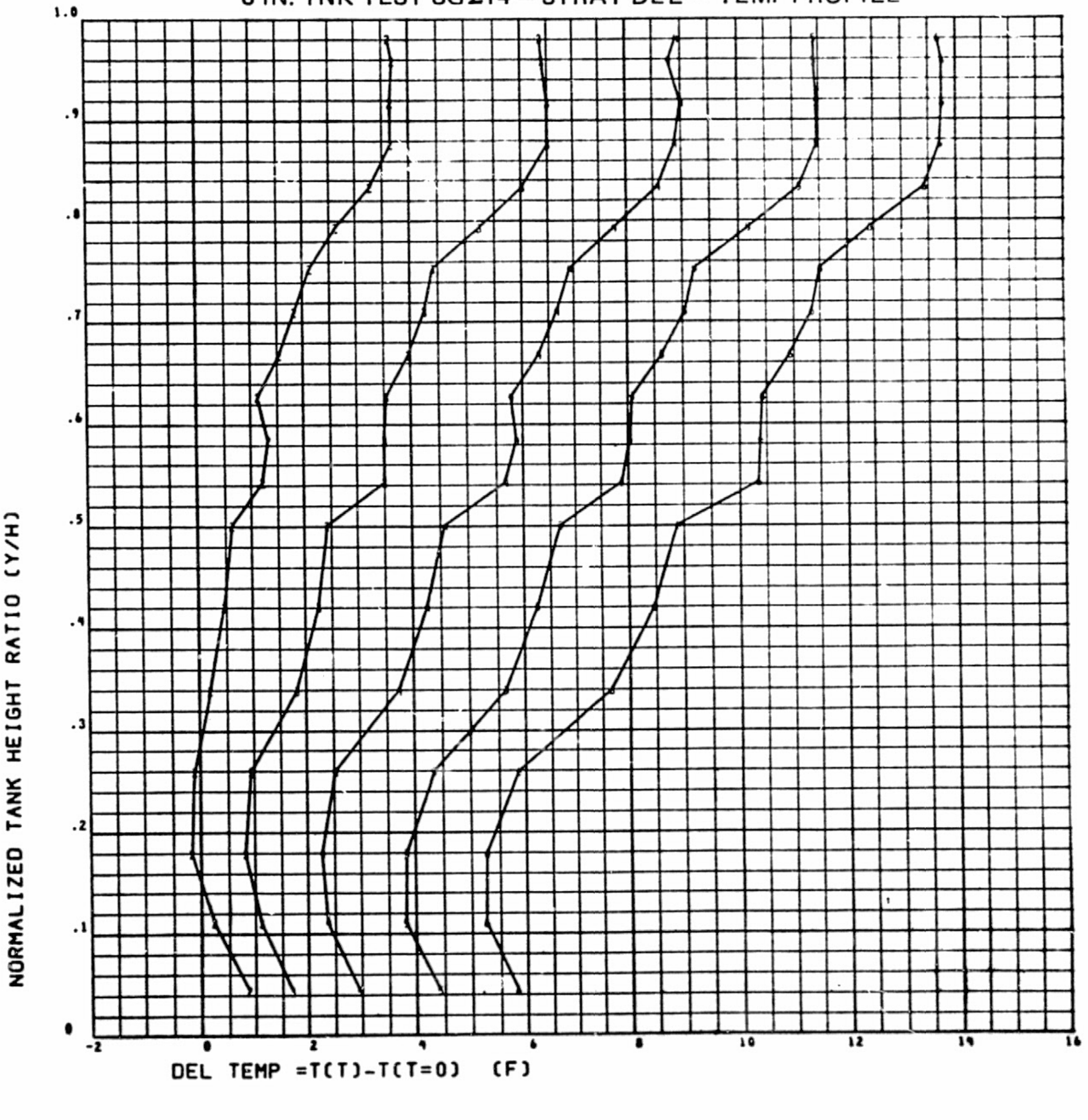


FIGURE 5.7-2b
12 IN. TNK TEST 1GΣ26 – STRAT DEL – TEMP PROFILE

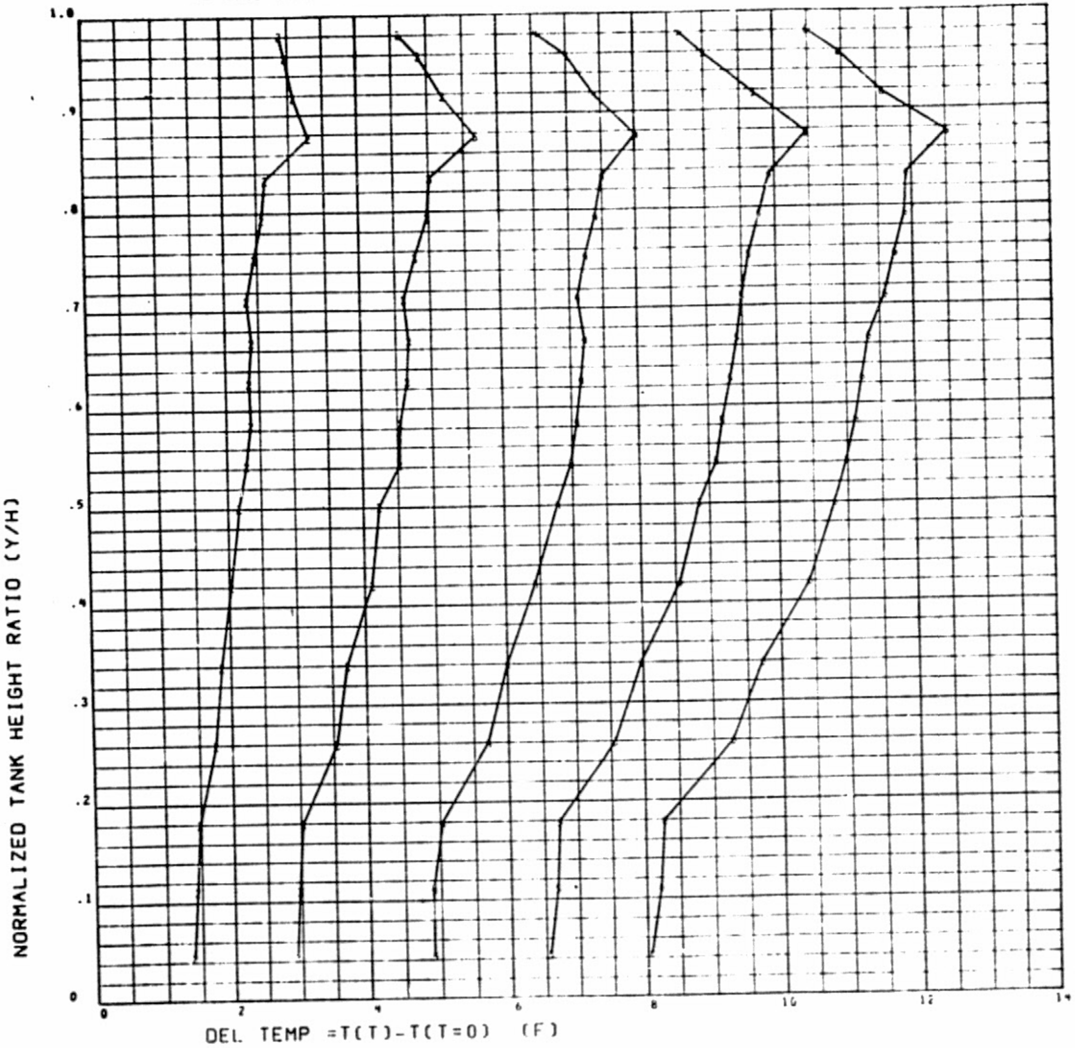


FIGURE 5.7-2c
12 IN. TNK TST1G15 STRAT DEL – TEMP PROFILE

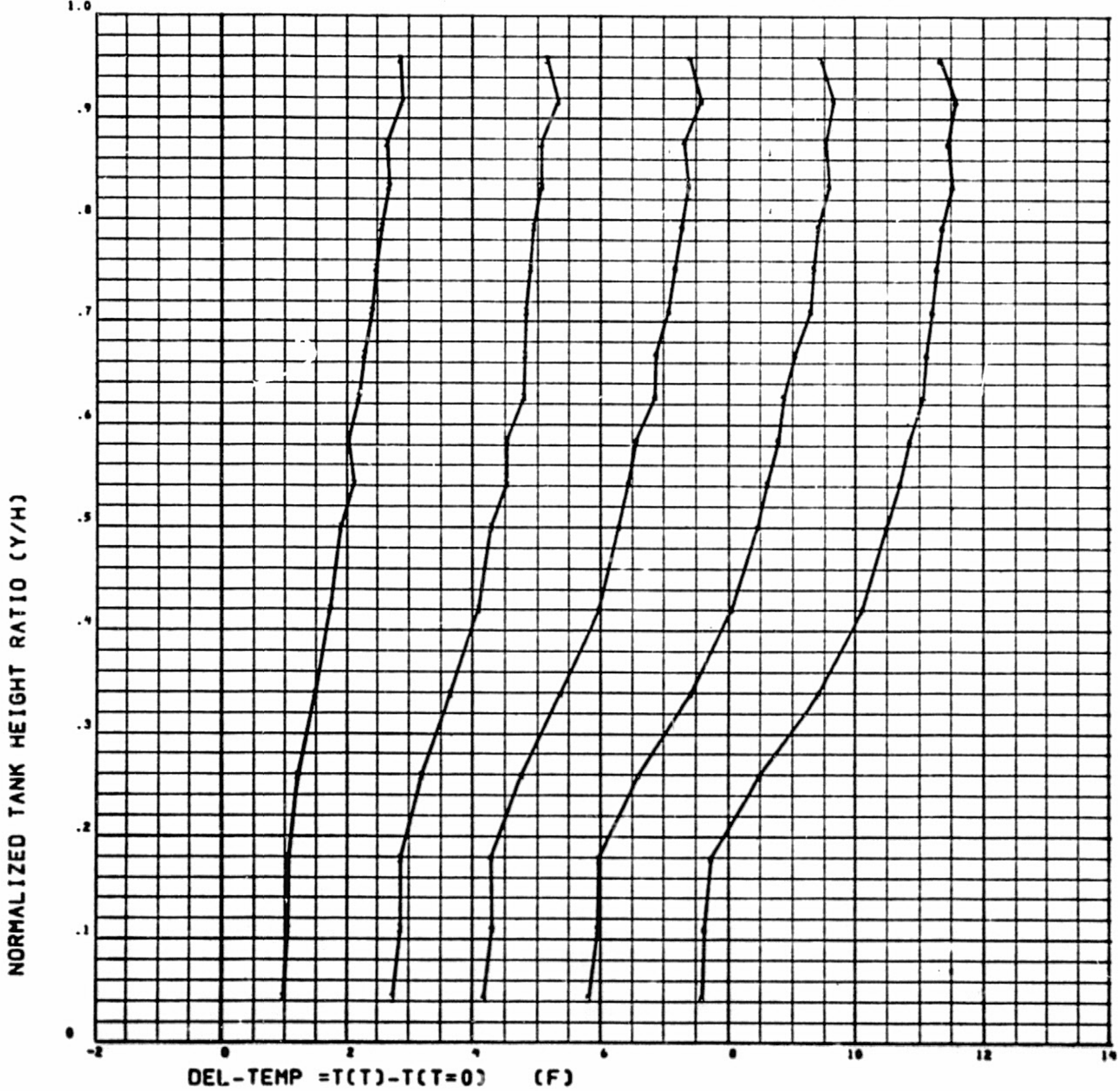


FIGURE 5.7-3a
6 IN. TNK TEST 8GΣ14 – STRAT DTNORM PROFILE

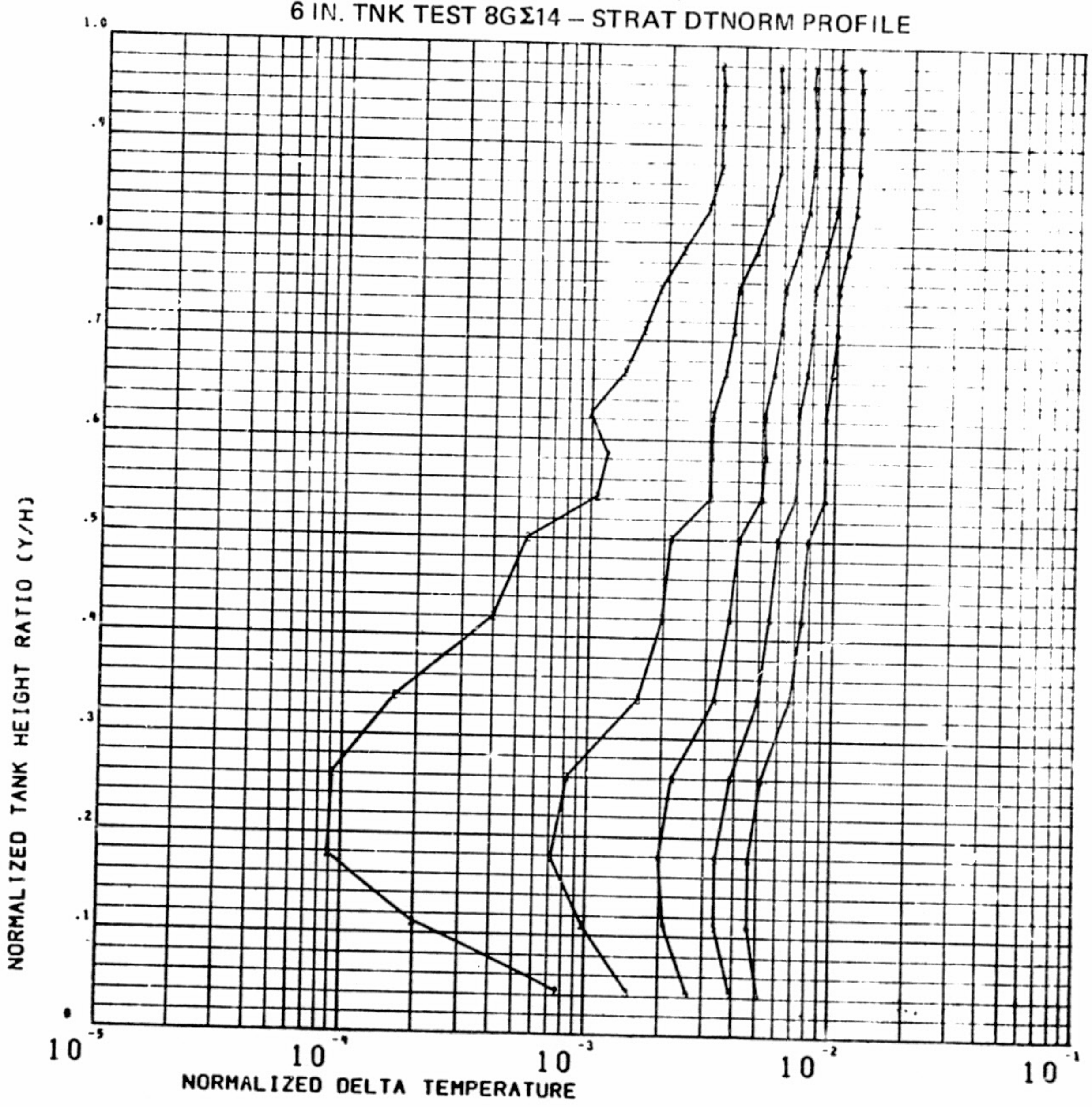


FIGURE 5.7-3b

12 IN. TNK TEST 1GΣ26 – STRAT DTNORM PROFILE

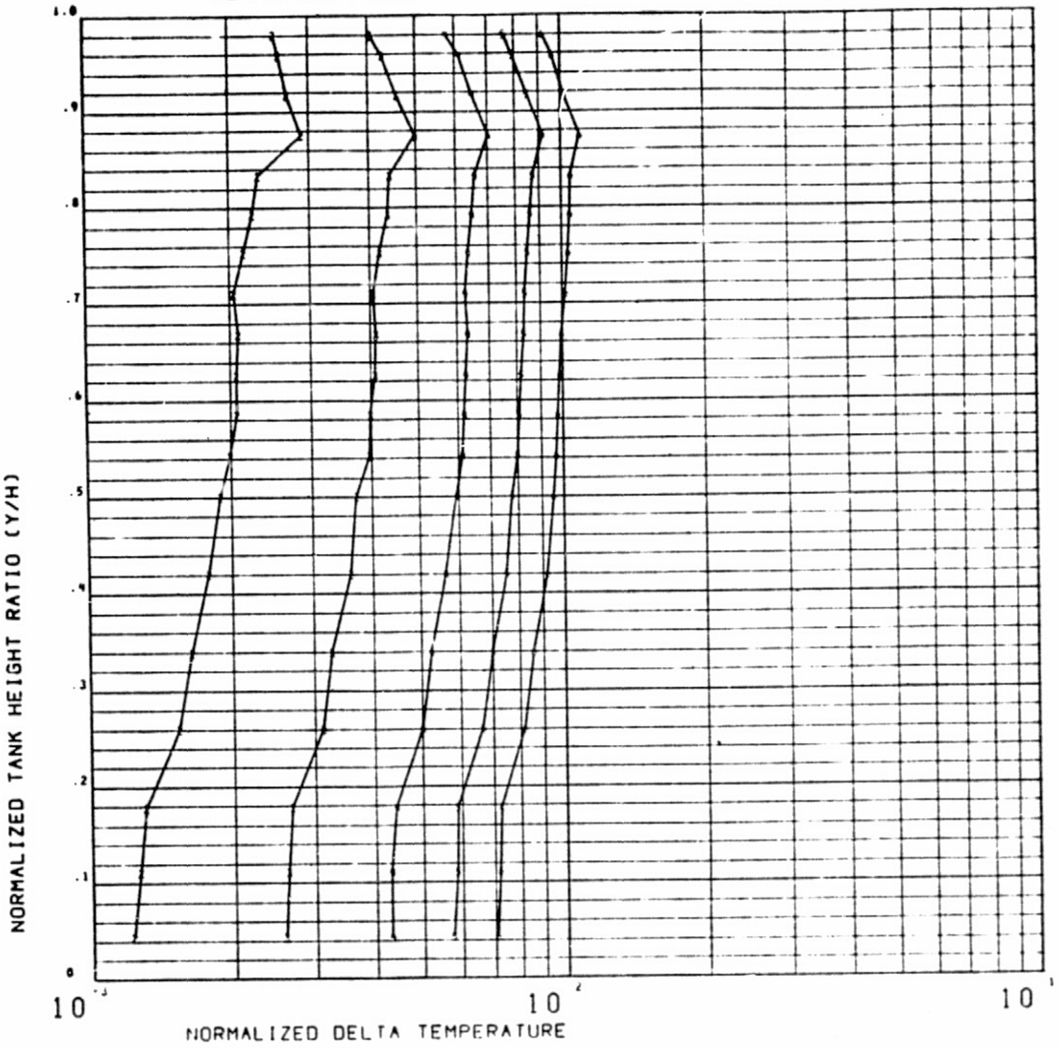


FIGURE 5.7-3c
12 IN. TNK TST1G15 STRAT DTNORM PROFILE

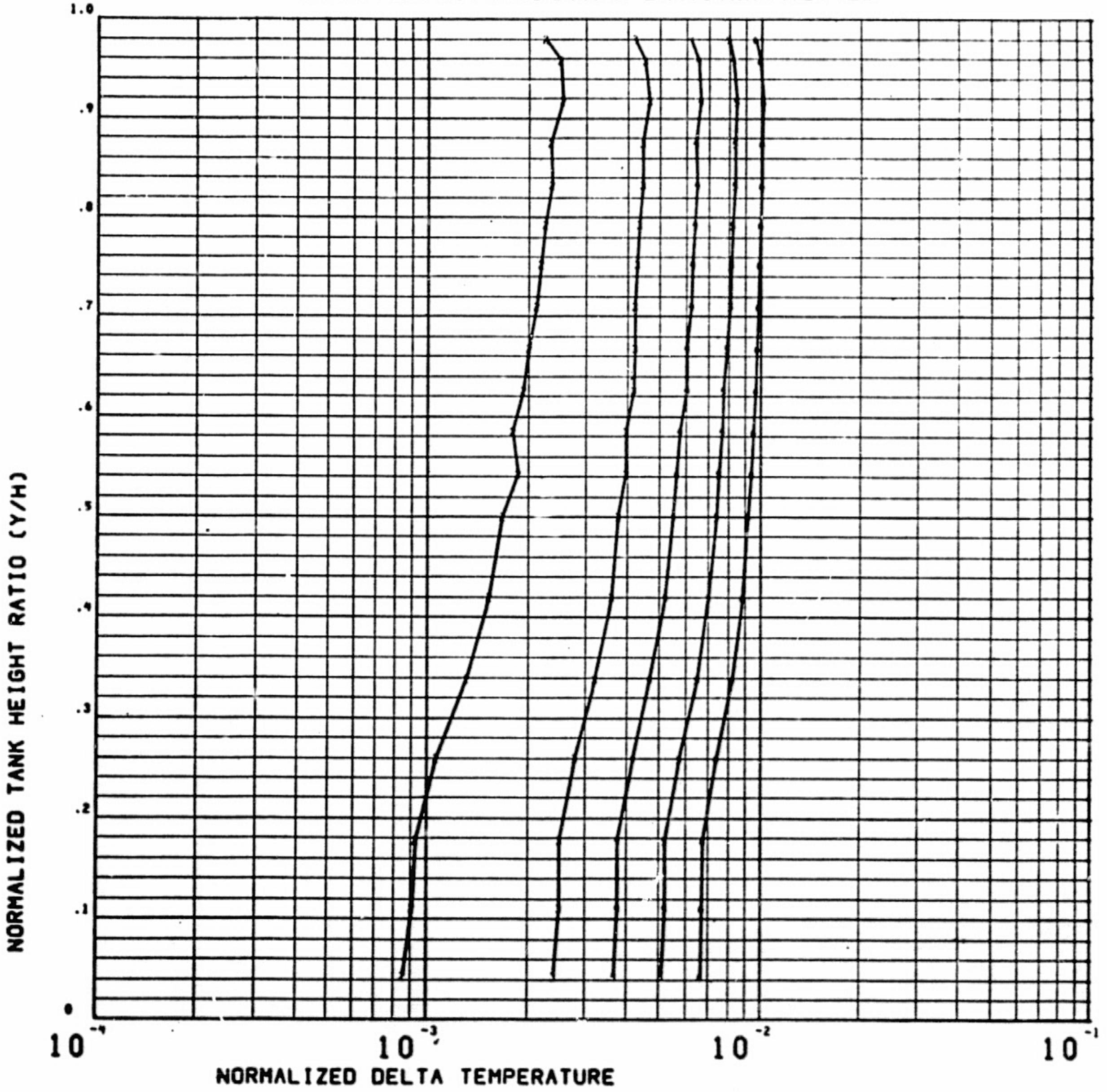


FIGURE 5.7-4a
6 IN. TNK TEST 8GΣ14 – BULK ULGEγ LIQ TEMP HISTORIES

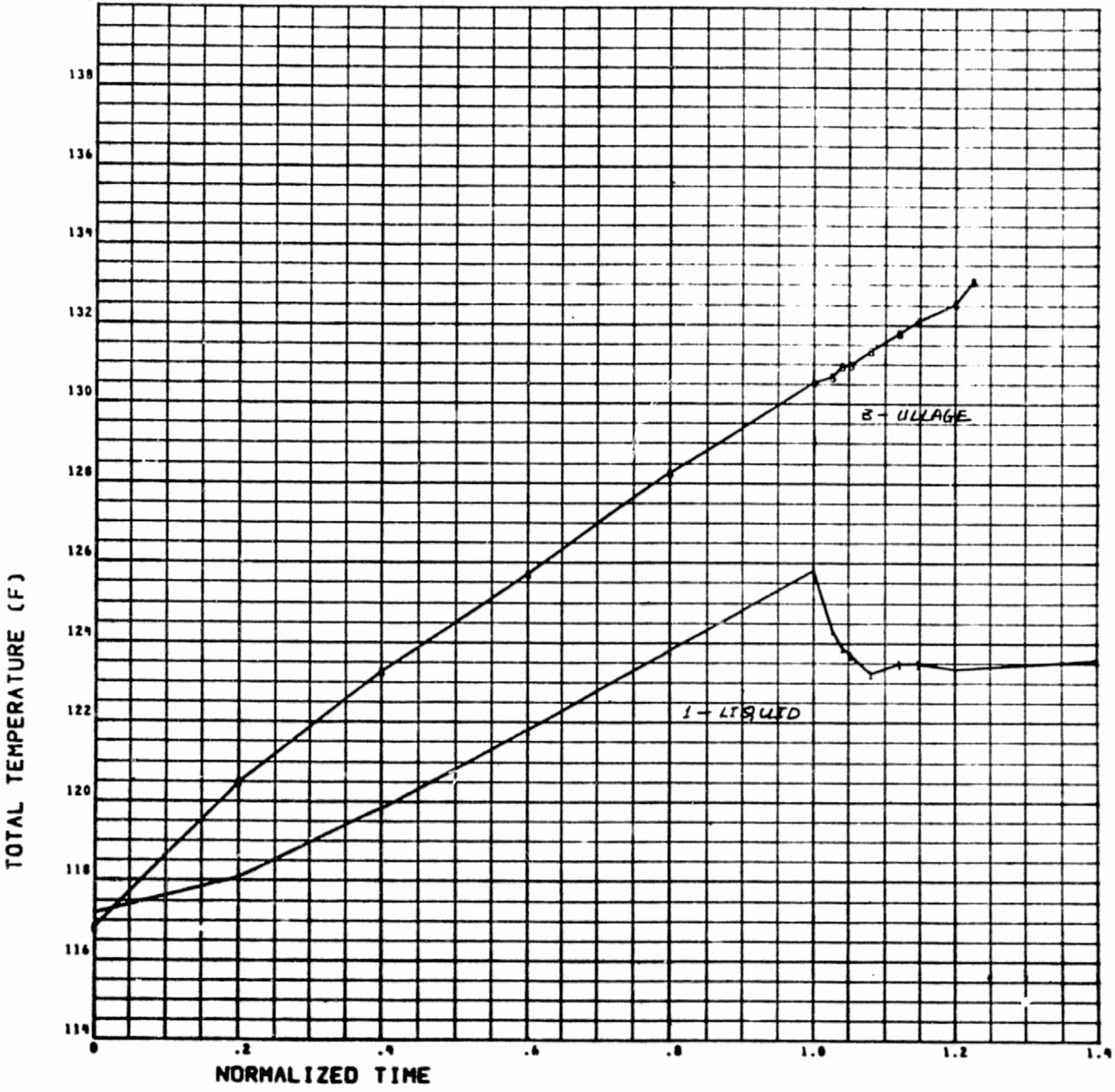


FIGURE 5.7-4b

12 IN. TNK TEST 1GΣ26 – BULK ULGE γ LIQ TEMP HISTORIES

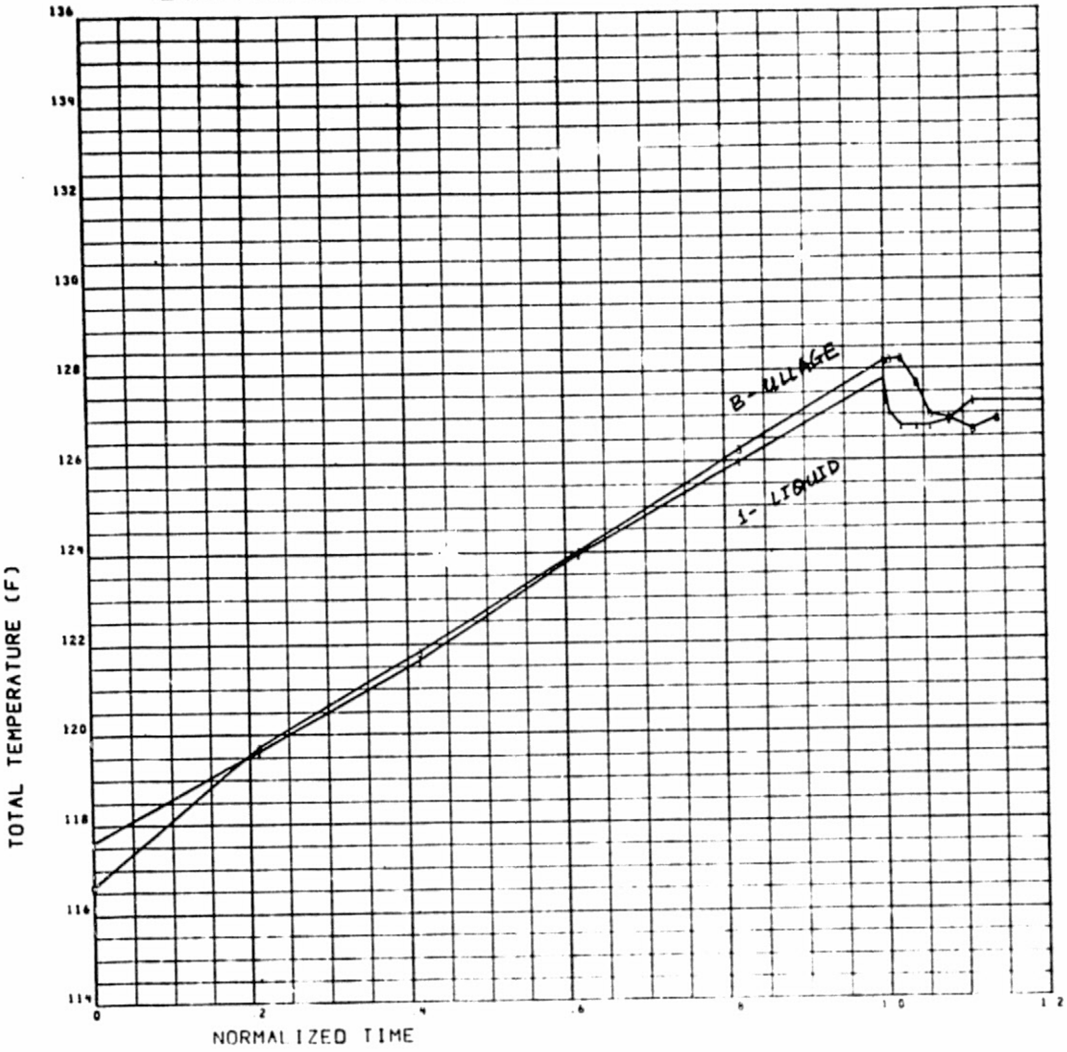
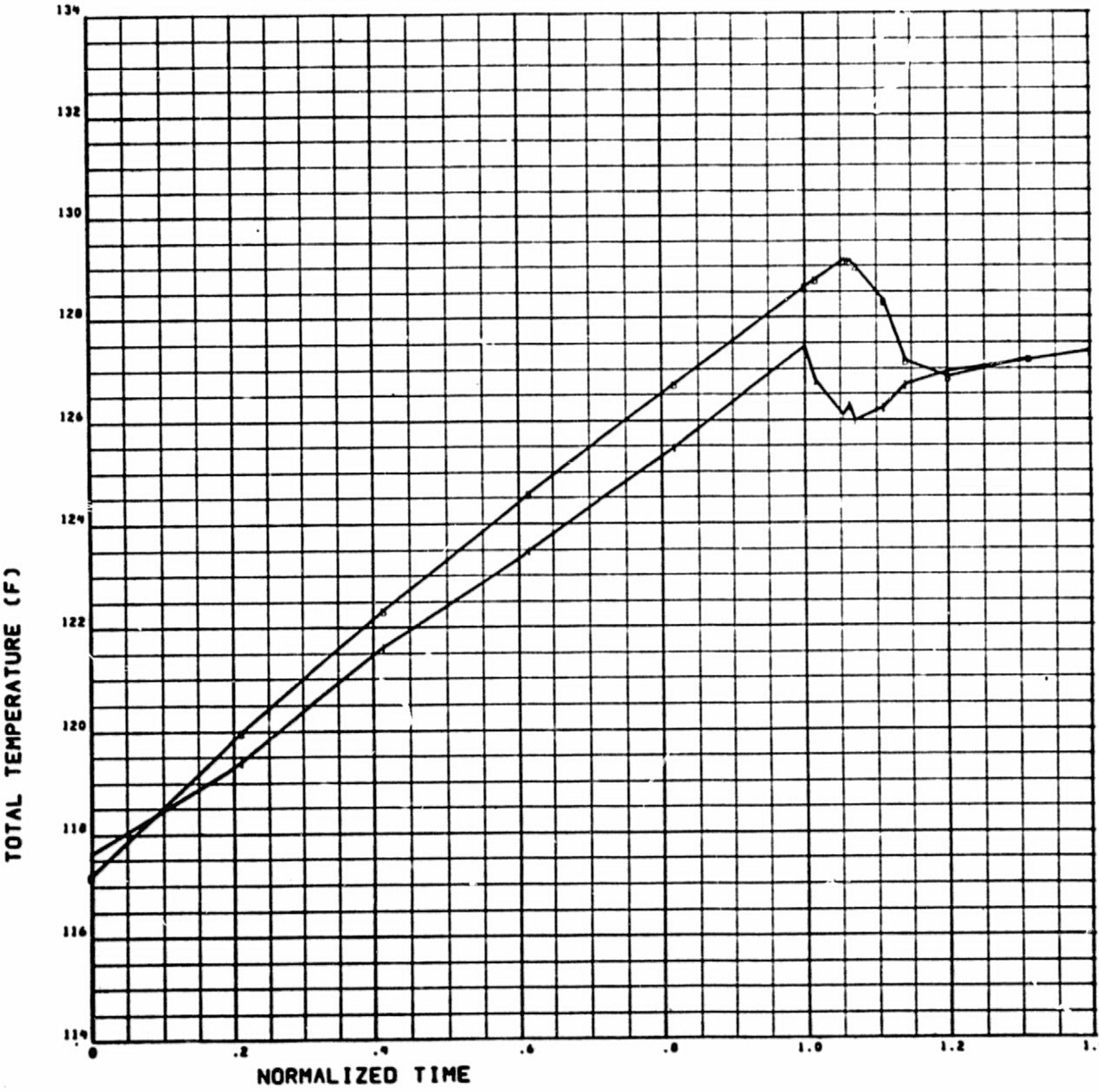


FIGURE 5.7-4c
12 IN. TNK TST1G15 BULK ULGE Y LIQ TEMP HISTORIES



B - ULLAGE
1 - LIQUID

FIGURE 5.7-5a
6 IN. TNK TEST 8GΣ14 – TANK PRESSURE HISTORY

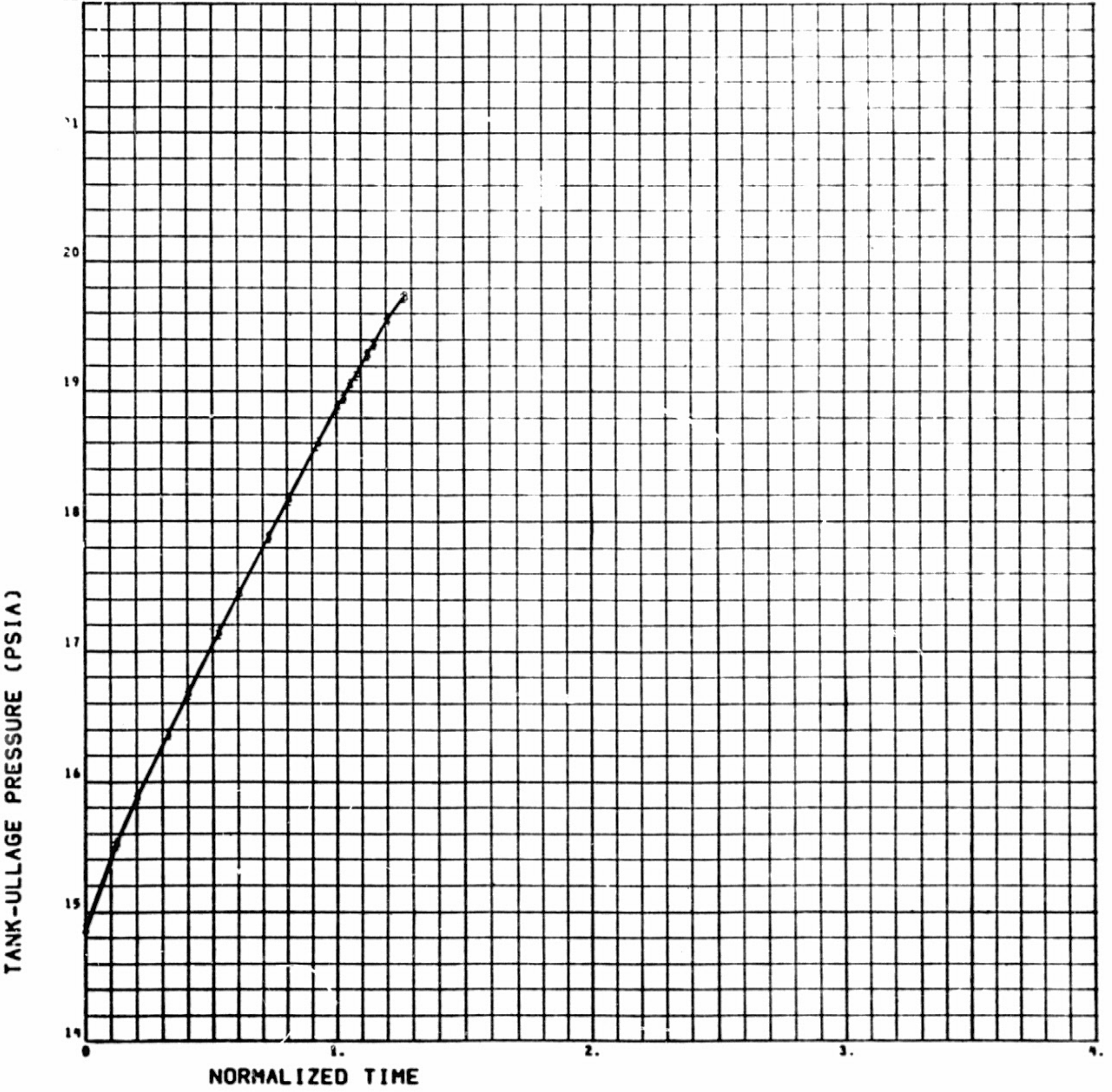
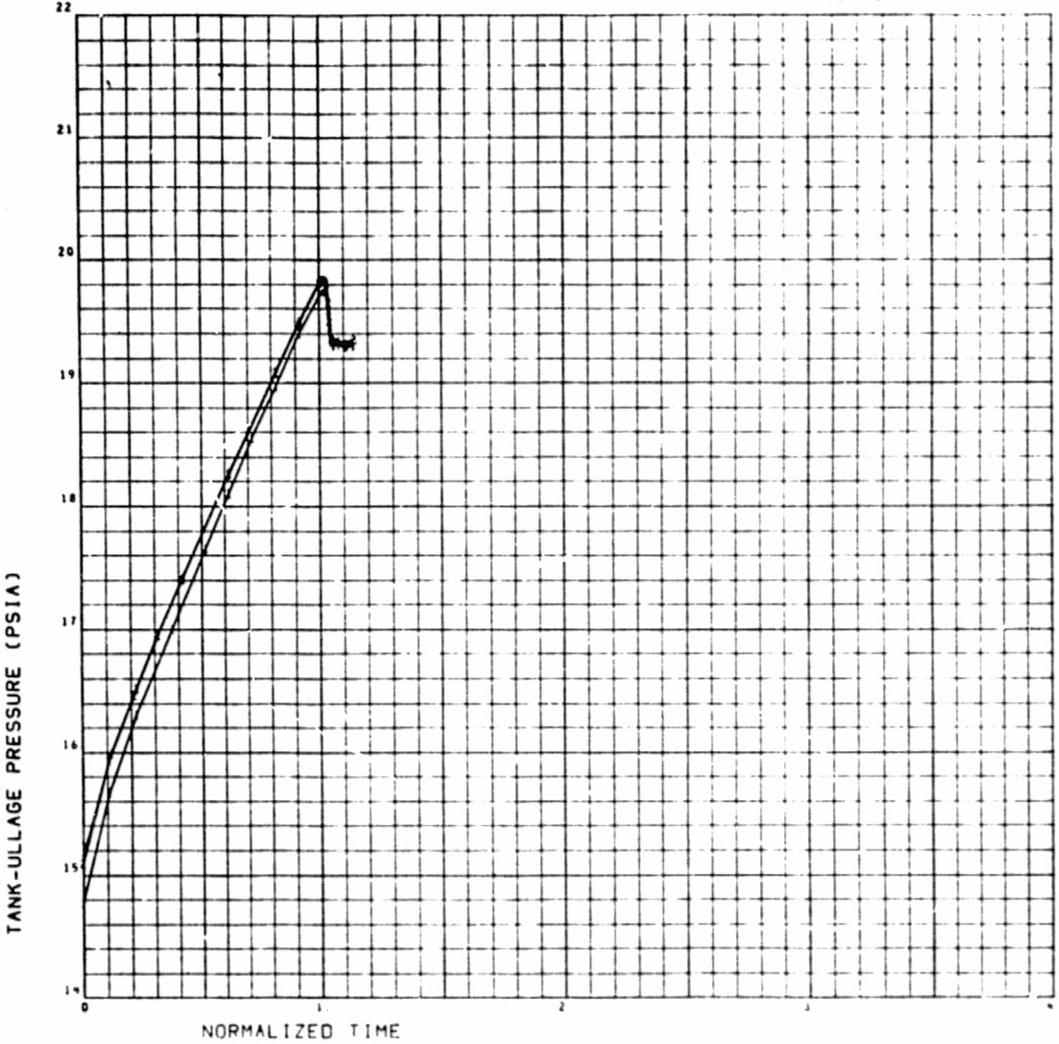


FIGURE 5.7-5b
12 IN. TNK TEST 1GΣ26 – TANK PRESSURE HISTORY



1 - Gage measured
2 } - Transducer measured
3 }

FIGURE 5.7.5c
12 IN. TNK TST1G15 TANK PRESSURE HISTORY

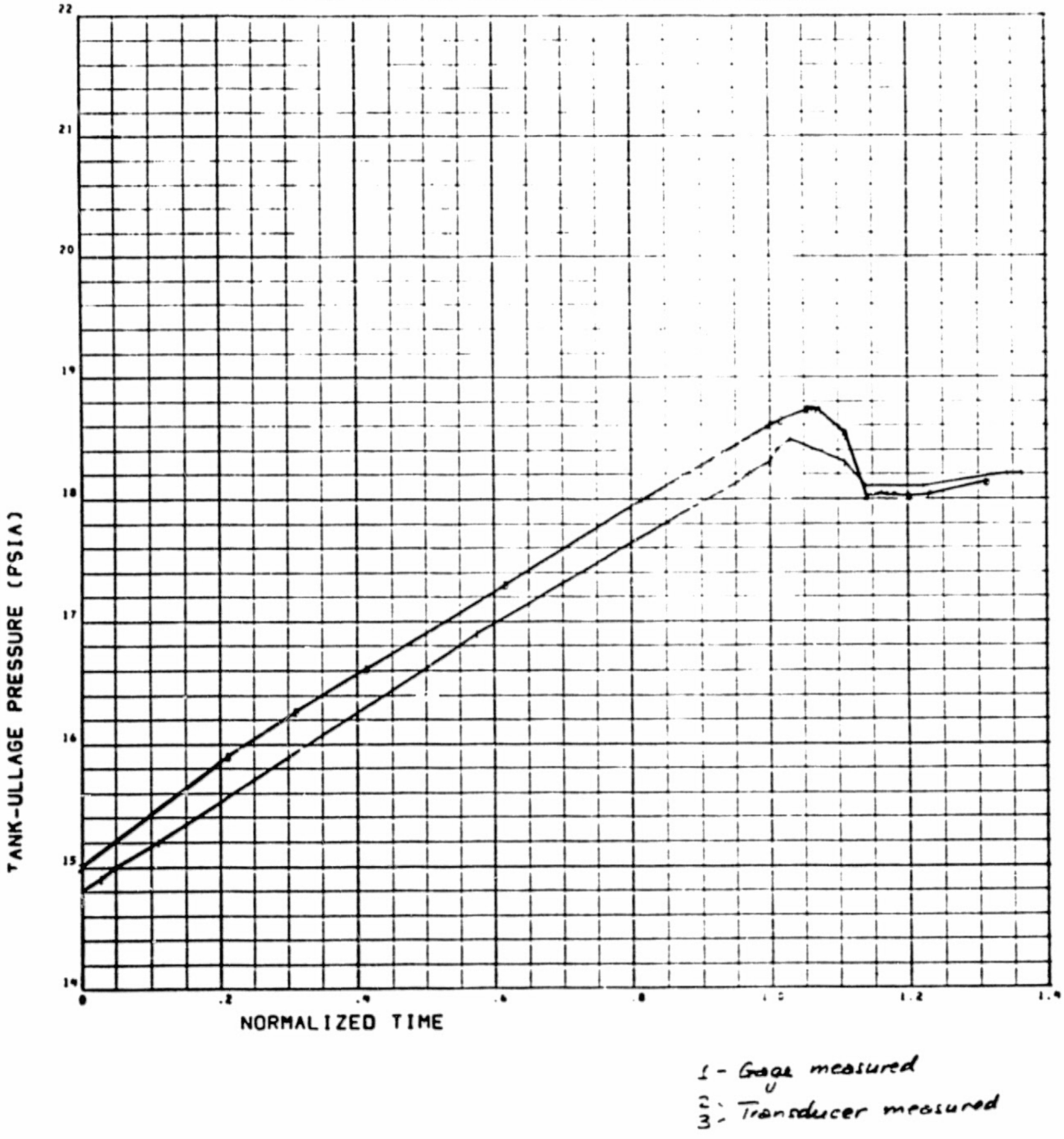
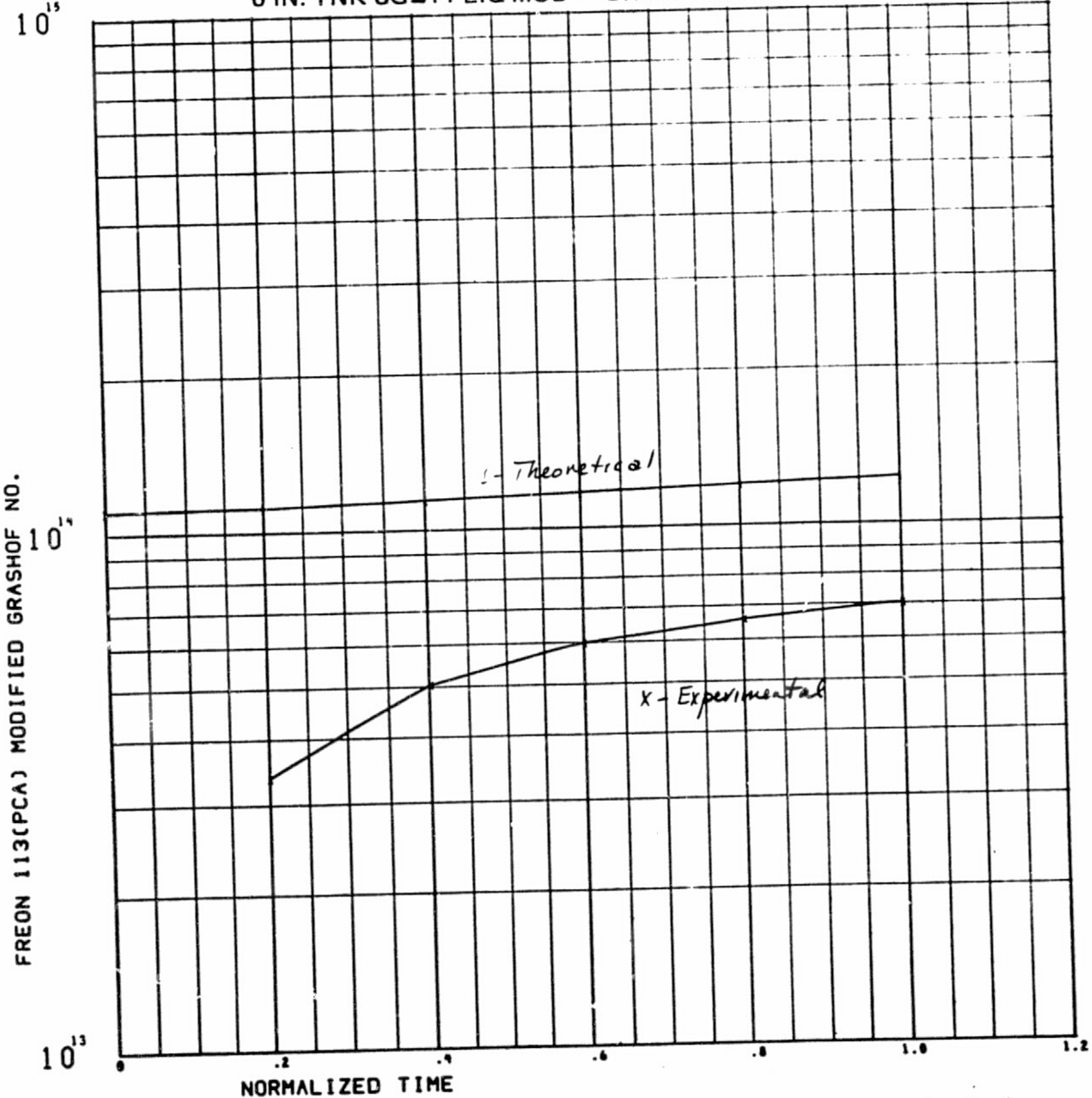


FIGURE 5.7-6a

6 IN. TNK 8GΣ14 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2}\left(\frac{q''L}{k}\right)$$

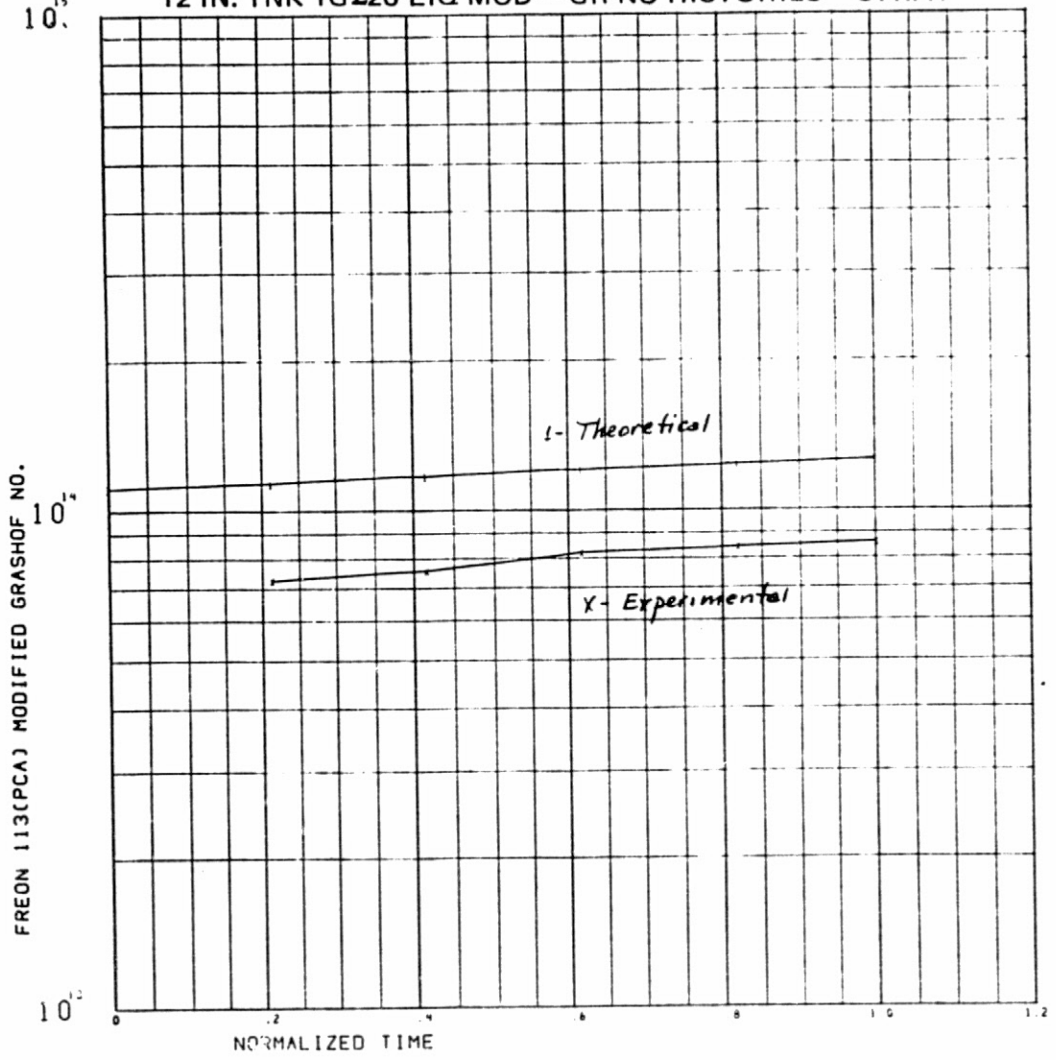
L = Fluid depth

I = Based on $\frac{q''}{\delta_H}$ wattage measured input

X = Based on experimentally determined $q'_{fluid(l)}$

FIGURE 5.7-6b

12 IN. TNK 1GΣ26 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

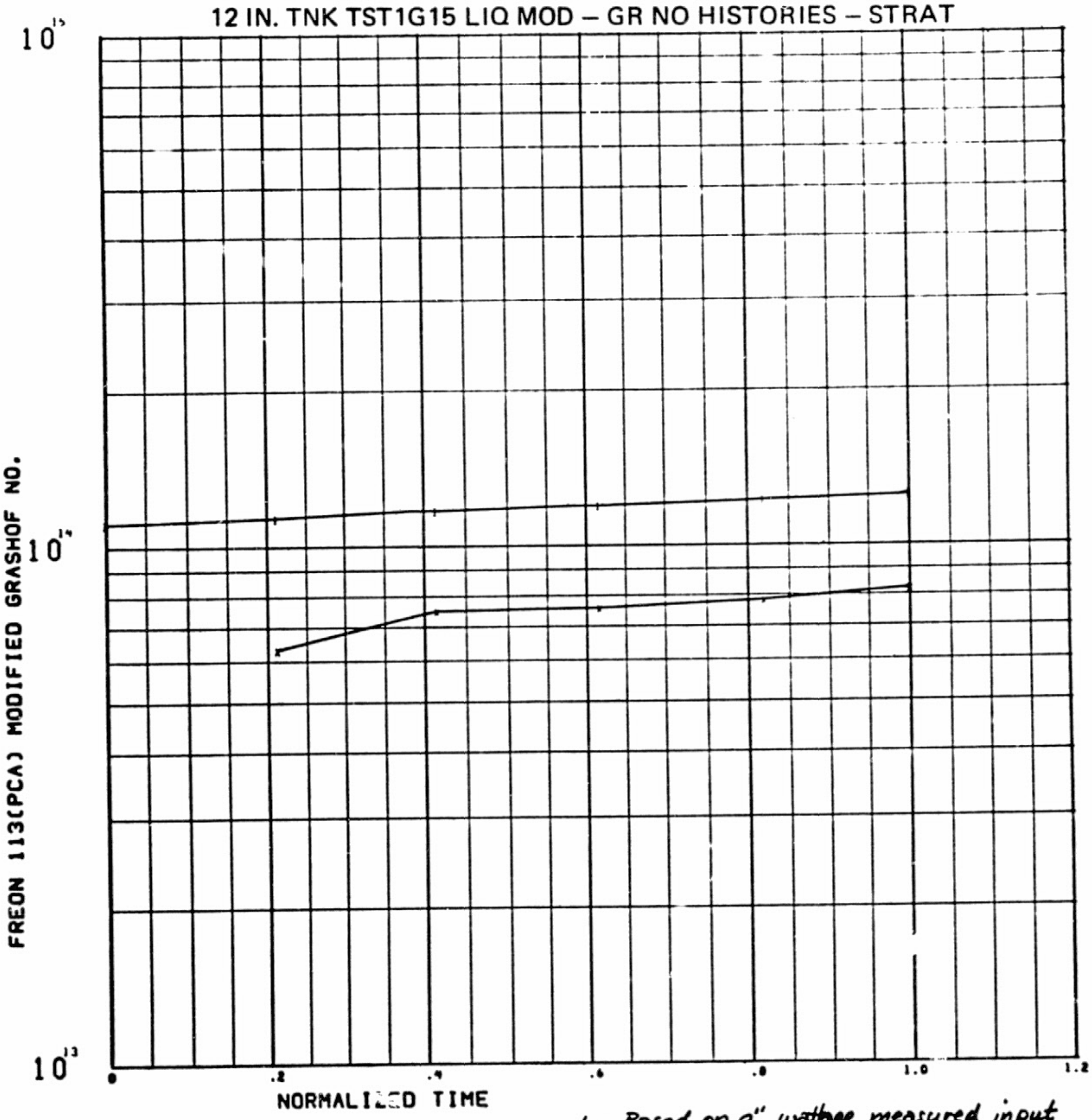
1 = Based on q''_H wattage measured input

X = Based on experimentally determined $q''_{fluid(\ell)}$

L = Fluid depth

FIGURE 5.7-6c

12 IN. TNK TST1G15 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)^2_\ell}\left(\frac{q''_\delta L}{k}\right)$$

L = Fluid depth

1 – Based on $q''_{\delta H}$ wattage measured input

X – Based on experimentally absorbed $q''_{\delta\, fluid(\ell)}$

FIGURE 5.7-7a

6 IN. TNK 8GΣ14 LIQ FOURIER NO HISTORY

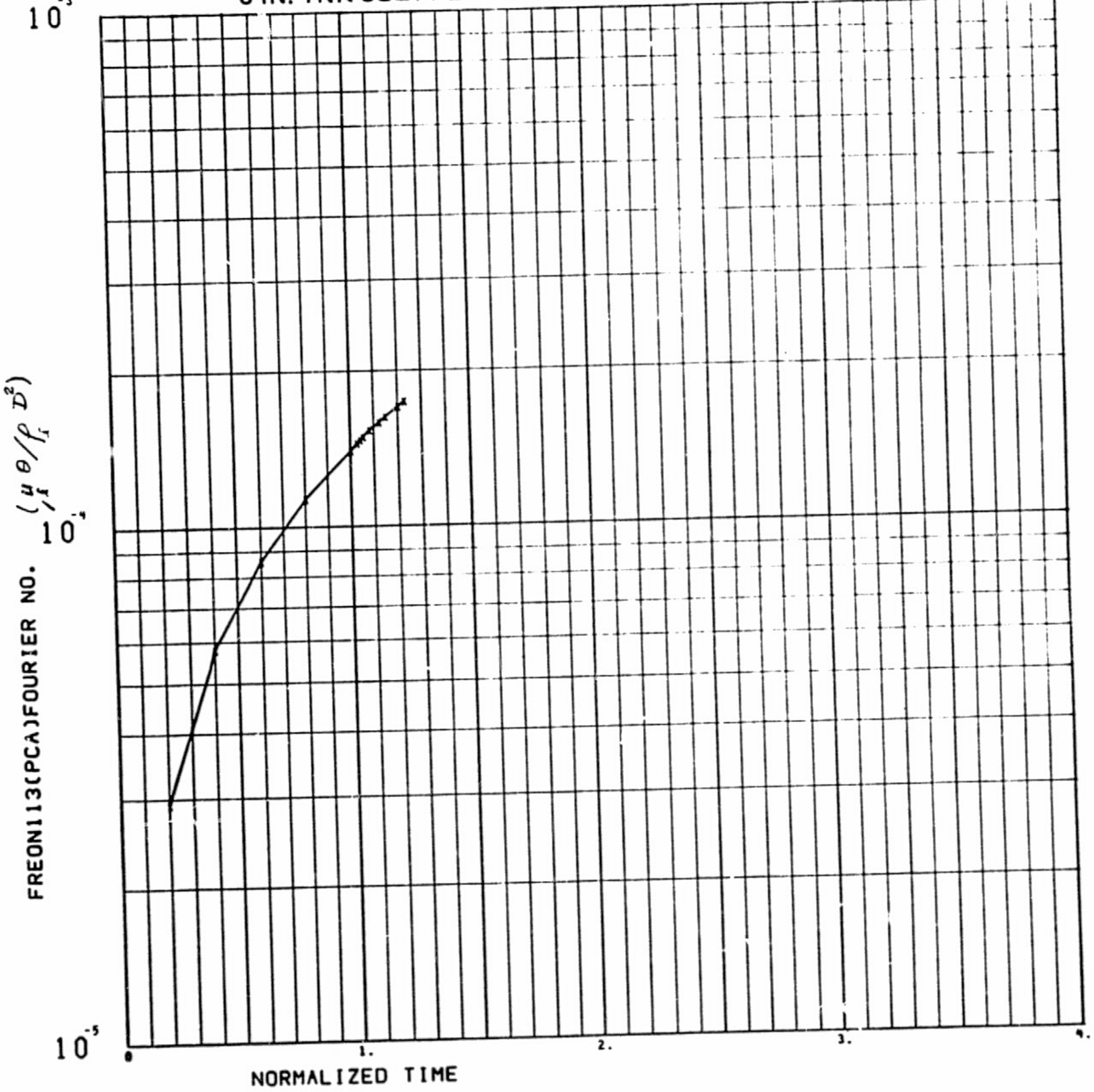


FIGURE 5.7-7b

12 IN. TNK 1GΣ26 LIQ FOURIER NO HISTORY

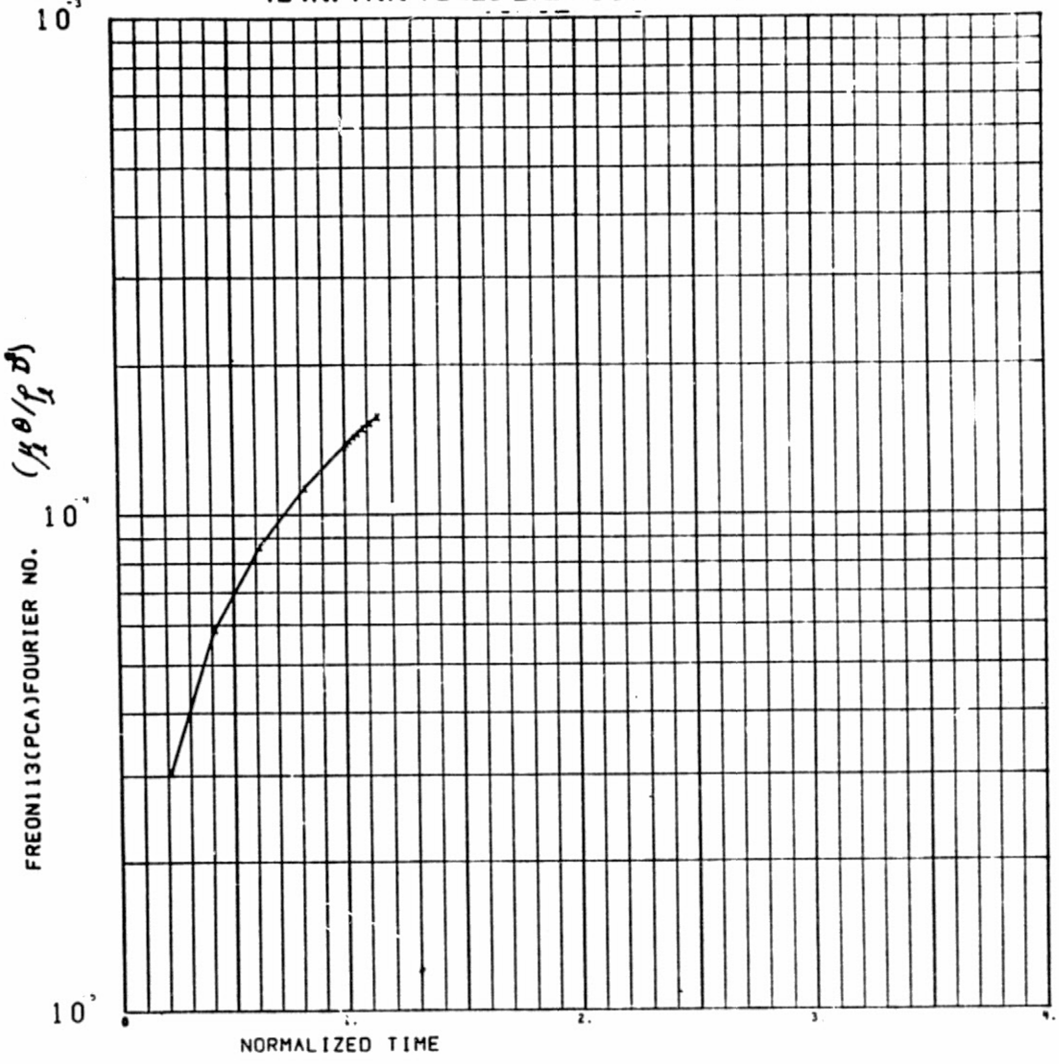
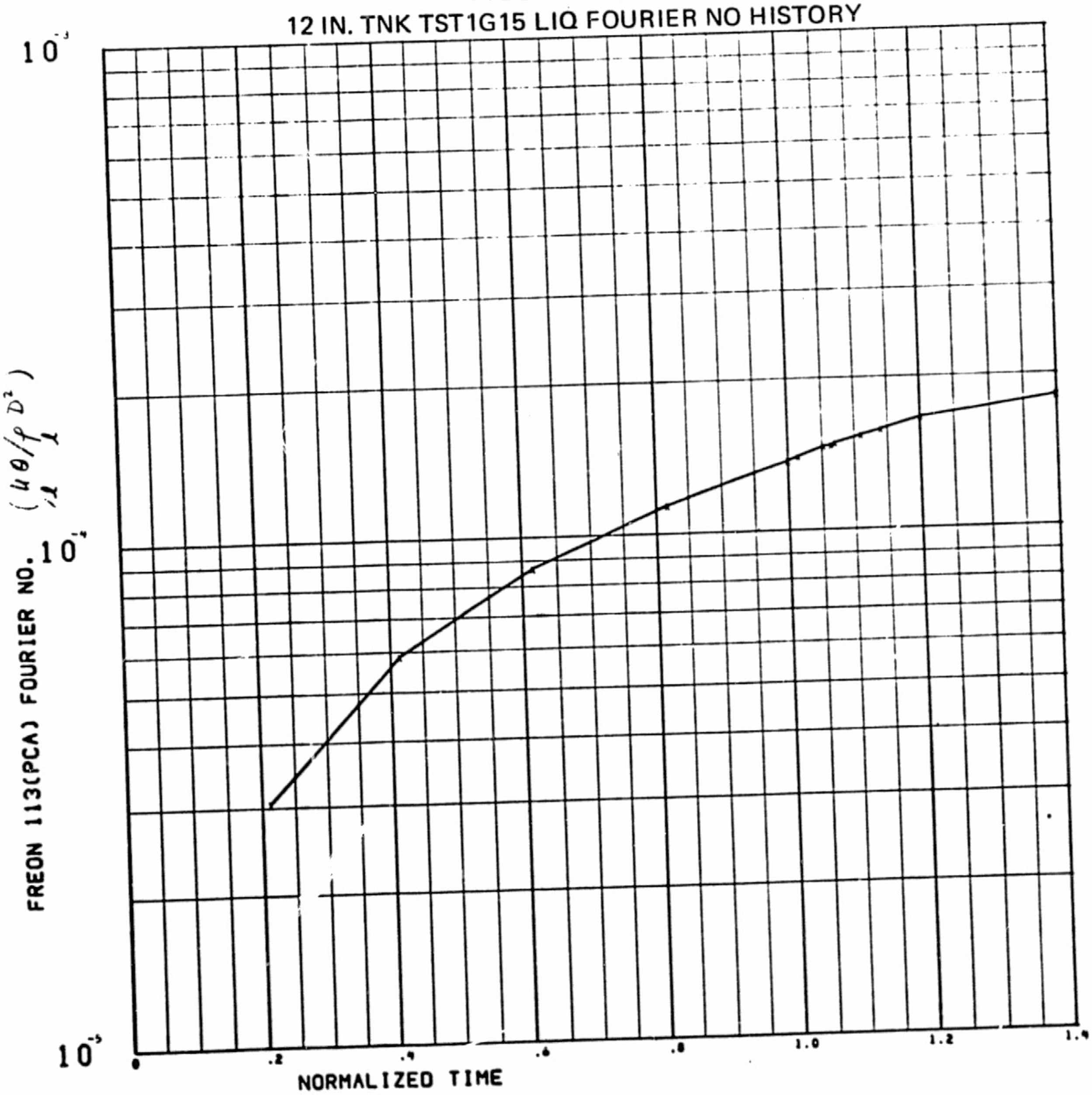


FIGURE 5.7-7c
12 IN. TNK TST1G15 LIQ FOURIER NO HISTORY



Section 5.8

SCALING SET

6-in.-Dia Tank Test	12-in.-Dia Tank Test
8G	1G
Test #13	Test #27

Table 5.8-1a. 6 IN. DIA. TANK TEST 8G#13

```
STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    ,3927       CYL AREA FT2=  1,5708       FLNGE AREA FT2=    ,0365
 DME WALL VOL FT3=    ,00131      1/2 CYL WALL VOLFT3=    ,00164     FLNGE VOL FT3=     ,00076
 DME MASS LBM=    ,65596      MASS 1/2 CYL LBM=     ,81996      FLANGE MASS=    ,38058

  LIQ VOL FT3=    ,22907      ULLAGE VOL FT3=     ,03272

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12=  90,1273    H34=  90,1273    H56=  90,1273    H910=  90,1273    H78=  90,1273

 EST,HT FLUX IN LIQ (BTU/HR-FT2)=  90,1273
 EST,HT FLUX IN ULLGE (BTU/HR-FT2)=  90,1273
 EST,HT INPUT LIQ(STRAT)BTU=    73,735       (STRAT+DESTRAT)BTU=   85,533
 EST,LIQ TEMP INCRSE(STRAT)=   15,1310F      (STRAT+DESTRAT)=   17,5567F

 EST,HT INPUT ULLAGE(STRAT)BTU=    14,747      (STRAT+DESTRAT)BTU=   17,107
```

Table 5.8-1b. 12 IN. DIA. TANK TEST 1G#27

```
STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  1,5708       CYL AREA FT2=  6,2832       FLNGE AREA FT2=    ,1458
 DME WALL VOL FT3=    ,01047      1/2 CYL WALL VOLFT3=    ,01309      FLNGE VOL FT3=     ,00608
 DME MASS LBM=  5,24772      MASS 1/2 CYL LBM=  6,55965      FLANGE MASS=  3,04465

  LIQ VOL FT3=  1,83260       ULLAGE VOL FT3=    ,26180

  INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

 H12=  45,0637   H34=  45,0637   H56=  44,9334   H910=  45,0637   H78=  45,0637

 EST,HT FLUX IN LIQ (BTU/HR-FT2)=  45,0116
 EST,HT FLUX IN ULLGE (BTU/HR-FT2)=  45,0637
 EST,HT INPUT LIQ(STRAT)BTU=  583,309       (STRAT+DESTRAT)BTU=  718,824
 EST,LIQ TEMP INCRSE(STRAT)=  14,0503F      (STRAT+DESTRAT)=  18,4319F

 EST,HT INPUT ULLAGE(STRAT)BTU=  116,797      (STRAT+DESTRAT)BTU=  143,939
```

Table 5.8-2a. 6 IN. DIA TANK TEST 8G #13 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	5,000	8,000	10,000	15,000	20,000	25,000
TAU	0,000	,200	,320	,400	,600	,800	1,000
1	117,292	123,708	126,417	128,000	132,042	135,750	139,000
2	117,375	124,625	126,792	128,083	131,667	134,750	137,875
3	117,667	124,000	125,917	127,167	130,292	133,292	136,083
4	117,875	123,708	125,438	126,500	129,417	132,083	134,708
5	117,125	122,250	123,792	124,708	127,458	129,875	132,208
6	117,208	121,958	123,375	124,208	126,500	128,750	130,875
7	117,354	121,500	122,833	123,500	125,479	127,417	129,250
8	117,500	121,042	122,292	122,792	124,458	126,083	127,625
9	116,083	117,958	118,708	119,292	120,667	122,167	123,625
10	117,250	122,708	125,033	126,250	130,042	133,292	136,417
11	117,438	122,417	123,875	125,083	128,083	130,917	133,583
12	117,583	121,375	122,958	123,958	126,375	128,792	131,083
13	117,083	120,500	121,292	121,667	123,333	124,833	126,458
14	116,167	121,458	123,958	125,333	129,500	132,875	135,875
15	116,625	122,708	125,167	126,500	129,833	133,208	136,250
16	117,000	122,667	124,417	125,667	123,292	131,000	133,583
17	116,479	121,104	122,417	123,292	125,500	127,625	129,667
18	115,958	117,542	120,417	120,917	122,708	124,250	125,750
19	115,203	117,542	118,333	118,708	120,125	121,583	122,958
20	117,250	122,708	125,033	126,250	130,042	133,292	136,417
21	117,458	122,417	123,875	125,083	128,083	130,917	133,583
22	117,583	121,375	122,958	123,958	126,375	128,792	131,083
23	117,083	120,500	121,292	121,667	123,333	124,833	126,456
24	116,667	130,917	135,500	138,125	143,667	148,292	152,000
25	116,250	122,125	125,000	126,833	131,167	135,000	138,292
26	116,229	122,000	124,750	126,563	130,896	134,708	137,938
27	116,208	121,875	124,500	126,292	130,625	134,417	137,583
28	116,625	126,083	131,875	135,333	143,333	149,917	155,375
29	116,208	127,625	133,250	136,667	144,375	150,917	156,208
30	116,417	137,875	143,958	147,083	153,500	158,625	162,583
31	116,146	120,250	120,667	121,146	122,333	123,938	125,417
32	116,542	120,875	121,167	121,792	122,875	124,583	126,042
33	114,875	117,583	117,833	118,208	119,625	121,042	122,250
34	111,000	113,208	113,708	114,167	115,208	116,458	117,542

Table 5.8-2a. 6 IN. DIA TANK TEST 8G #13 (Page 2 of 2)

35	106,500	108,125	108,500	108,792	109,458	110,500	111,417
36	115,750	119,625	120,167	120,500	121,792	123,292	124,792
37	116,750	125,667	133,000	136,875	144,917	151,417	156,833
38	116,708	122,792	130,750	134,625	142,625	149,042	154,042
39	116,875	123,125	128,042	131,333	138,333	144,000	148,542
40	117,042	122,792	125,875	128,083	134,958	139,583	143,292
41	117,333	122,292	124,750	126,375	129,958	133,708	137,000
42	117,417	122,208	124,792	126,292	130,083	133,708	136,917
43	117,792	122,000	124,625	126,250	130,250	133,875	137,042
44	117,750	122,667	124,833	126,500	130,417	134,167	137,250
45	117,625	121,875	124,208	125,792	129,917	133,708	137,125
46	117,375	122,083	124,750	126,583	130,750	134,125	137,667
47	117,875	122,417	124,625	126,333	130,458	134,083	137,292
48	117,146	120,854	122,875	124,333	127,750	131,146	134,333
49	116,958	119,417	121,000	122,292	125,542	128,583	131,667
50	117,250	119,458	121,000	122,292	125,417	128,333	131,333
51	117,000	119,042	120,375	121,833	124,625	127,583	130,458
52	117,771	119,750	121,229	122,521	125,333	128,271	131,167
53	116,667	118,542	119,708	121,167	123,917	126,917	129,708
54	118,542	120,458	122,083	123,208	126,042	128,958	131,875
55	118,375	120,667	122,000	123,292	126,083	129,083	131,958
56	118,542	120,458	122,083	123,208	126,042	128,958	131,875
57	118,375	120,667	122,000	123,292	126,083	129,083	131,958
58	116,875	118,542	119,750	121,167	123,833	126,417	129,458
59	118,042	119,708	120,750	122,125	124,792	127,542	130,167
60	119,333	120,958	122,208	123,458	126,000	128,542	131,083
61	116,375	117,042	117,875	119,083	121,458	123,917	126,333
62	116,625	116,958	117,792	118,750	121,083	123,125	125,625
63	117,583	118,042	118,958	120,042	122,208	124,375	126,833
64	118,542	119,083	120,167	120,917	123,333	125,208	127,500
65	116,333	115,917	116,583	117,542	119,333	121,542	123,417
66	116,458	116,042	116,292	117,208	118,542	120,250	122,125
67	117,250	117,292	117,542	118,250	119,667	121,458	123,208
68	116,250	116,042	116,229	116,958	118,292	119,750	121,479
69	116,000	115,542	115,833	116,417	117,542	119,125	120,375
70	116,042	116,042	116,167	116,708	118,042	119,250	120,833
71	116,583	116,875	117,167	117,833	118,875	120,292	121,500
72	117,208	118,083	118,583	119,292	120,417	121,750	123,292
73	115,167	115,833	115,875	116,542	117,667	119,125	120,292
74	108,375	112,417	114,833	116,750	120,458	123,875	126,958
75	94,250	97,750	99,333	100,917	103,625	106,167	108,250
76	103,750	104,667	105,083	105,792	107,292	108,667	110,292
77	88,333	87,833	87,667	88,125	88,667	89,333	90,292

Table 5.8-2b. 12 IN. DIA TANK TEST 1G #27 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

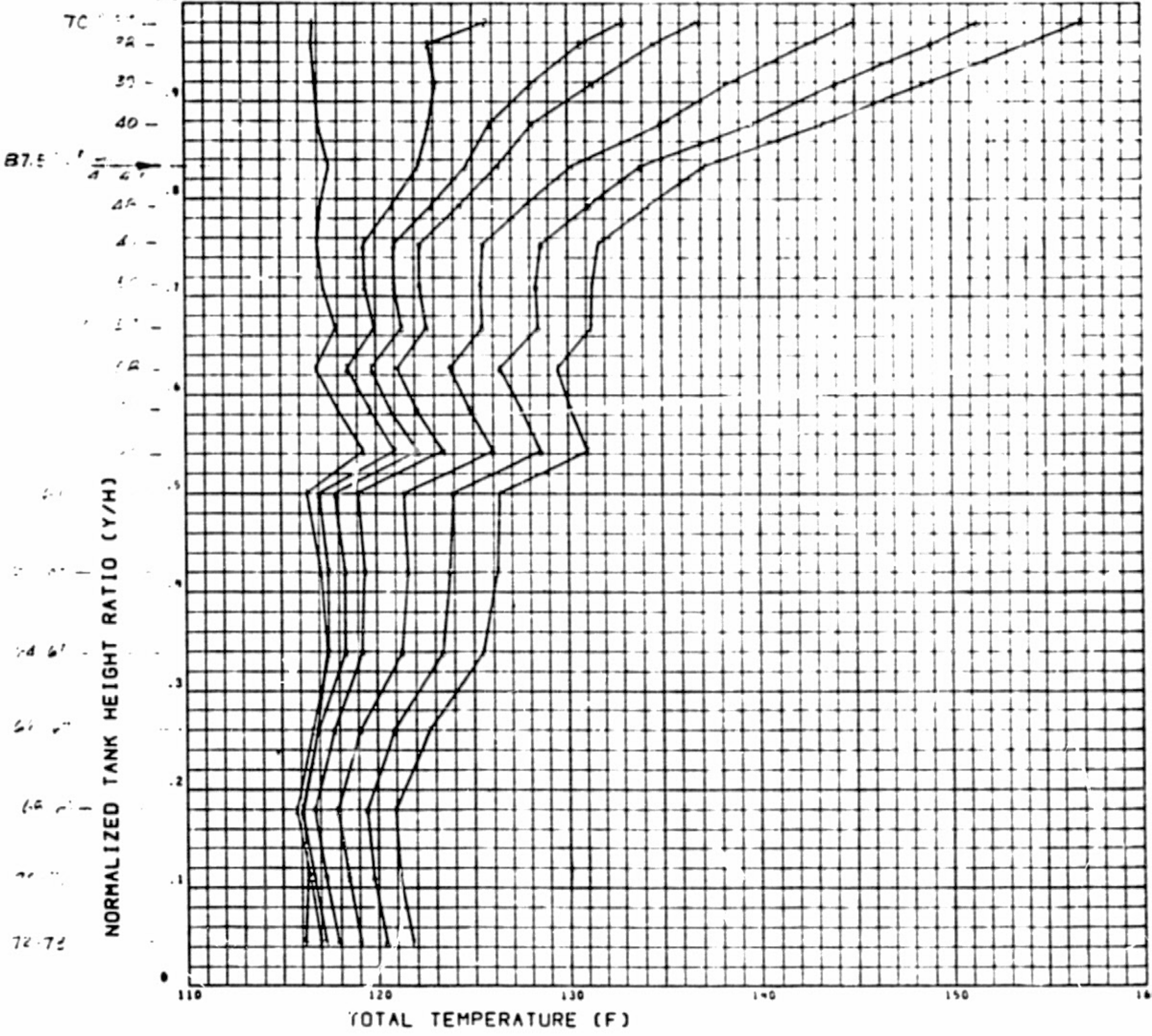
TIME(MIN)	0,000	10,000	20,000	30,000	40,000	50,000	60,000	80,000	99,000
TAU	0,000	,101	,202	,303	,404	,505	,606	,808	1,000
1	117,333	119,958	121,750	123,583	125,333	127,125	129,042	132,417	135,458
2	117,375	120,500	122,000	123,458	124,917	126,583	128,125	130,958	133,833
3	117,750	120,750	122,167	123,542	124,958	126,417	127,875	130,583	133,208
~~4~~	~~117,958~~	~~120,750~~	~~122,000~~	~~123,333~~	~~124,667~~	~~126,000~~	~~127,542~~	~~130,042~~	~~132,417~~
5	117,708	120,625	121,708	123,042	124,250	125,625	127,000	129,333	131,625
6	117,708	120,083	121,167	122,250	123,375	124,625	125,875	128,042	130,167
7	117,750	120,000	121,042	122,000	123,125	124,250	125,458	127,625	129,625
8	116,000	120,042	120,917	121,792	122,708	123,792	124,833	125,625	128,500
9	116,083	119,167	119,917	120,625	121,417	122,458	123,458	125,125	126,875
10	117,500	121,583	123,083	124,583	125,958	127,625	129,208	132,083	134,833
11	117,708	121,458	122,750	124,083	125,292	126,708	128,208	130,792	133,208
12	117,333	121,125	122,333	123,417	124,583	125,875	127,208	129,333	131,583
13	117,583	120,792	121,625	122,542	123,417	124,458	125,542	127,417	129,292
14	117,042	119,917	121,583	123,333	125,125	126,875	128,833	132,167	135,125
15	117,583	121,625	123,083	124,583	126,042	127,500	129,125	132,125	134,958
~~16~~	~~117,750~~	~~121,375~~	~~122,667~~	~~123,833~~	~~125,208~~	~~126,625~~	~~128,042~~	~~130,667~~	~~133,083~~
17	117,542	120,875	122,000	123,083	124,167	125,458	126,792	129,042	131,208
18	117,500	120,250	121,083	121,958	122,833	123,833	125,083	125,875	128,750
19	117,375	118,667	119,333	120,125	120,917	121,875	122,917	124,667	126,292
20	117,708	121,708	123,167	124,667	126,167	127,708	129,333	132,208	134,958
21	117,458	121,375	122,667	123,917	125,250	126,625	128,083	130,667	133,125
~~22~~	~~117,542~~	~~120,917~~	~~122,042~~	~~123,125~~	~~124,250~~	~~125,583~~	~~126,917~~	~~129,083~~	~~131,292~~
23	117,583	120,708	121,625	122,375	123,208	124,292	125,417	127,375	129,125
24	116,625	124,000	128,833	133,042	136,333	139,792	142,667	147,500	150,375
25	116,542	121,167	125,500	129,292	132,500	135,542	138,417	143,042	147,042
26	116,333	120,625	124,583	128,167	131,292	134,250	137,000	141,625	145,500
27	116,333	120,542	124,625	128,125	131,333	134,250	137,083	141,708	145,500
~~28~~	~~119,042~~	~~127,500~~	~~136,333~~	~~143,500~~	~~149,292~~	~~154,292~~	~~158,583~~	~~165,417~~	~~170,667~~
29	116,792	124,208	130,875	137,208	142,958	148,042	152,542	159,583	164,958
30	117,125	129,333	136,000	140,792	144,792	148,292	151,542	155,667	160,708
31	117,583	120,458	121,250	122,042	122,875	123,833	124,917	125,667	128,292
32	117,417	120,250	120,958	121,708	122,542	123,458	124,458	125,167	127,792
33	116,000	117,292	117,375	117,625	117,917	118,333	118,875	119,792	120,792
~~34~~	~~115,583~~	~~114,375~~	~~113,125~~	~~112,167~~	~~111,375~~	~~110,875~~	~~110,708~~	~~110,208~~	~~110,167~~

Table 5.8-2b. 12 IN. DIA TANK TEST 1G #27 (Page 2 of 2)

35	115,417	112,708	110,500	108,667	107,167	105,875	105,042	103,458	102,625
36	117,875	120,750	121,542	122,292	123,208	124,125	125,167	125,958	128,708
37	118,625	126,208	135,542	142,458	147,625	151,958	155,708	161,792	166,292
38	118,208	123,833	131,000	136,167	140,667	144,667	148,375	154,333	158,958
39	117,625	120,833	125,667	131,292	134,292	137,792	141,083	145,375	150,667
40	117,250	120,217	124,917	128,417	131,625	134,542	137,250	141,917	144,875
41	117,750	119,292	121,000	122,625	124,292	125,958	127,875	131,208	134,333
42	117,792	119,500	121,125	122,708	124,375	126,167	127,917	131,292	134,375
43	117,917	119,583	121,250	122,875	124,542	126,208	128,167	131,417	134,500
44	118,083	119,833	121,458	122,958	124,708	126,417	128,250	131,500	134,583
45	117,792	119,583	121,250	122,833	124,458	126,167	128,125	131,458	134,458
46	117,750	119,708	121,333	122,917	124,417	126,083	128,000	131,292	134,333
47	117,917	119,708	121,333	123,042	124,625	126,417	128,250	131,625	134,708
48	118,167	119,708	121,292	122,750	124,292	125,917	127,583	130,708	133,583
49	118,042	119,500	121,042	122,417	123,917	125,417	127,042	130,042	132,750
50	117,917	119,292	120,750	122,083	123,542	124,917	126,542	129,375	131,917
51	118,042	118,833	120,333	121,583	122,958	124,417	125,875	128,833	131,292
52	117,217	119,083	120,583	121,792	123,167	124,625	126,083	128,958	131,417
53	117,750	119,042	120,542	121,667	123,083	124,500	125,917	125,875	131,333
54	117,958	119,208	120,667	121,917	123,375	124,750	126,208	129,083	131,583
55	117,917	119,167	120,542	121,750	123,208	124,625	126,125	125,958	131,542
56	117,917	119,083	120,583	121,792	123,208	124,583	126,083	129,042	131,500
57	117,875	119,042	120,583	121,792	123,042	124,583	126,083	128,958	131,500
58	118,042	119,083	120,542	121,708	123,083	124,458	125,875	123,708	131,208
59	117,833	118,833	120,208	121,333	122,667	124,042	125,417	125,292	130,625
60	117,750	118,792	120,042	121,125	122,417	123,750	125,083	127,833	130,083
61	117,833	118,625	119,917	120,917	122,208	123,458	124,875	127,500	129,625
62	117,958	118,750	119,917	120,958	122,125	123,292	124,542	127,042	129,208
63	117,750	118,458	119,750	120,583	121,875	123,042	124,333	125,792	128,917
64	117,667	118,333	119,500	120,208	121,292	122,458	123,625	125,083	128,083
65	117,708	118,375	119,500	120,292	121,375	122,583	123,708	125,083	128,125
66	117,708	118,375	119,500	120,292	121,375	122,583	123,708	125,083	128,125
67	117,667	118,167	119,167	119,875	120,917	121,958	123,000	125,208	127,000
68	117,625	118,125	119,083	119,625	120,625	121,583	122,583	124,625	126,292
69	117,708	118,125	119,083	119,708	120,667	121,625	122,625	124,708	126,375
70	117,750	118,125	119,083	119,708	120,667	121,625	122,625	124,708	126,375
71	117,583	118,000	118,917	119,542	120,458	121,458	122,500	124,500	126,167
72	117,625	118,042	118,875	119,542	120,458	121,458	122,458	124,458	126,208
73	117,667	118,042	118,917	119,542	120,417	121,500	122,542	124,500	12 ,125
74	97,583	97,458	97,917	98,458	99,250	100,292	101,375	103,458	105,083
75	107,167	107,625	109,083	110,375	112,000	113,708	115,375	118,500	120,958
▼76	89,375	89,375	89,333	89,042	89,042	89,167	89,333	89,533	90,000
77	100,792	100,583	100,583	100,417	100,625	100,958	101,333	102,250	103,042

FIGURE 5.8-1a

6 IN. TNK TEST 8GΣ13 – STRAT TEMPERATURE PROFILE

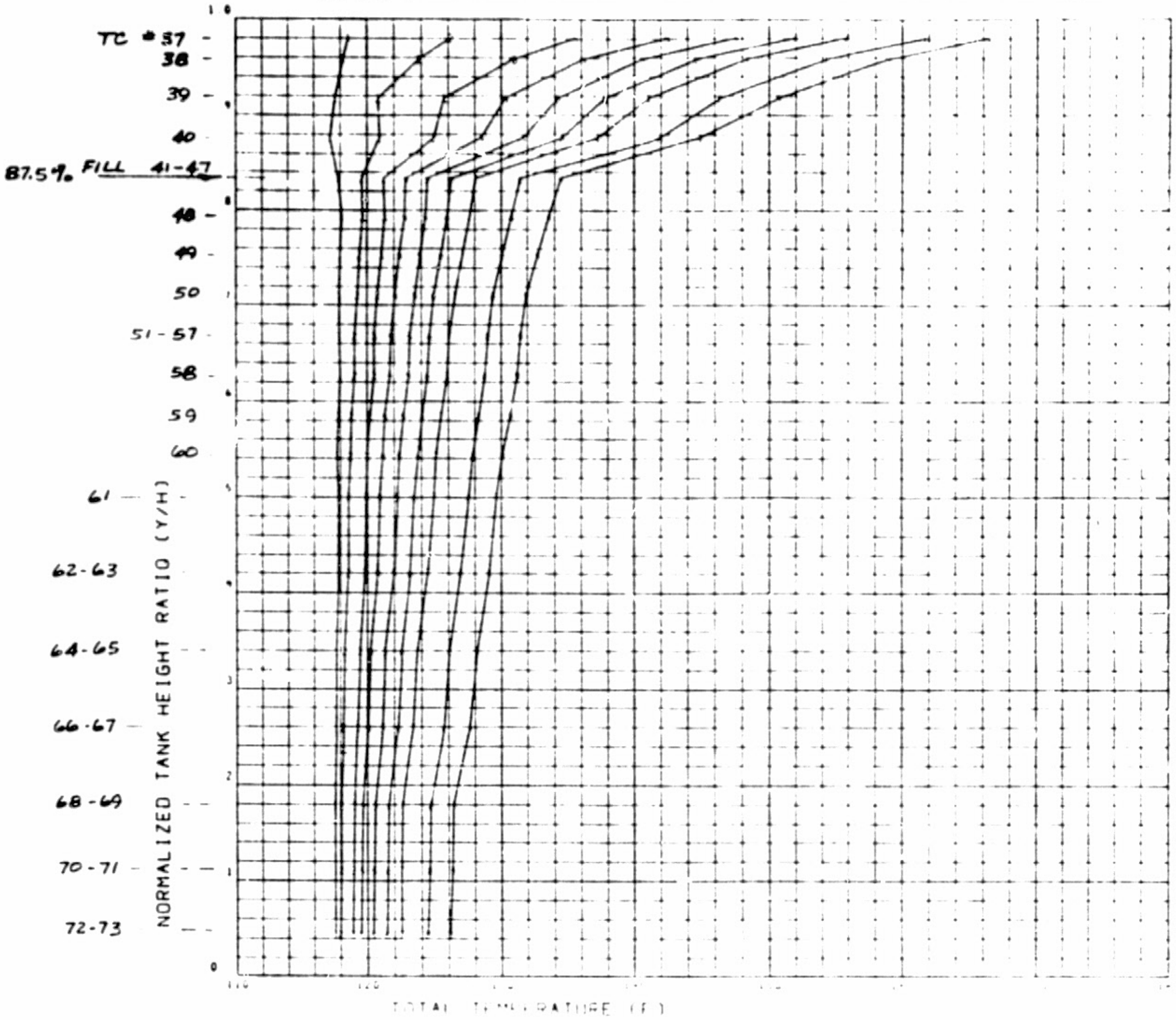


q''_{W} = 90 BTU/hr ft²

LIQ + ULLAGE HTG

	T (min.)	τ (hr)
1	0.	0.
2	5.	.2
3	8.	.32
4	10.	.4
5	15.	.6
6	20.	.8
7	25.	1.0

FIGURE 5.8-1b
12 IN. TNK TEST 1GΣ27 – STRAT TEMPERATURE PROFILE



$q''_H = 4.5$ BTU/hr ft^2
[illegible] + ULLAGE HTG

	T (min.)	τ (TAU)
1	0.	0.
2	10	.101
3	20	.202
4	30	.303
5	40	.404
6	50	.505
7	60	.606
8	80.	.808
9	99.	1.0

FIGURE 5.8-2a
6 IN. TNK TEST 8GΣ13 – STRAT DEL – TEMP PROFILE

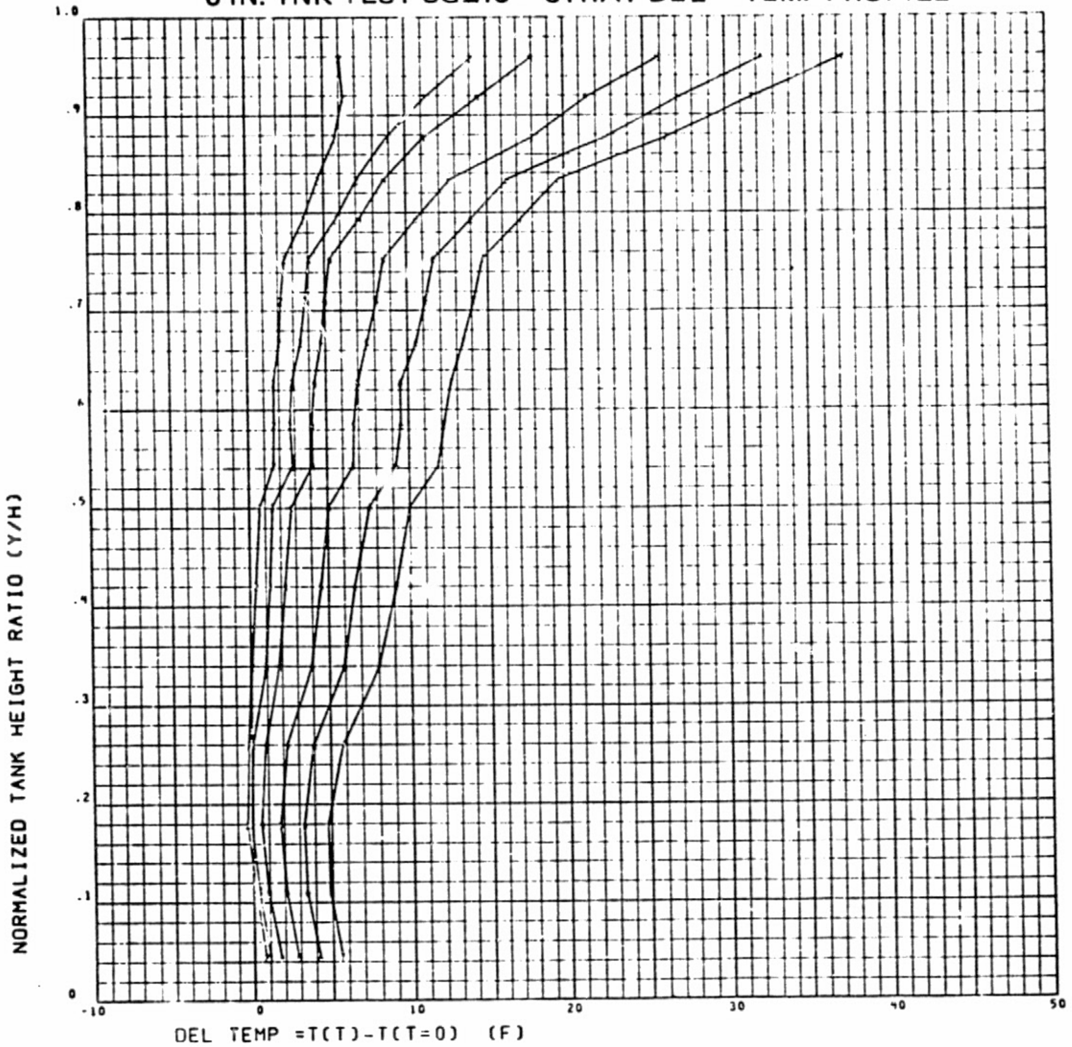


FIGURE 5.8-2b
12 IN. TNK TEST 1GΣ27 – STRAT DEL – TEMP PROFILE

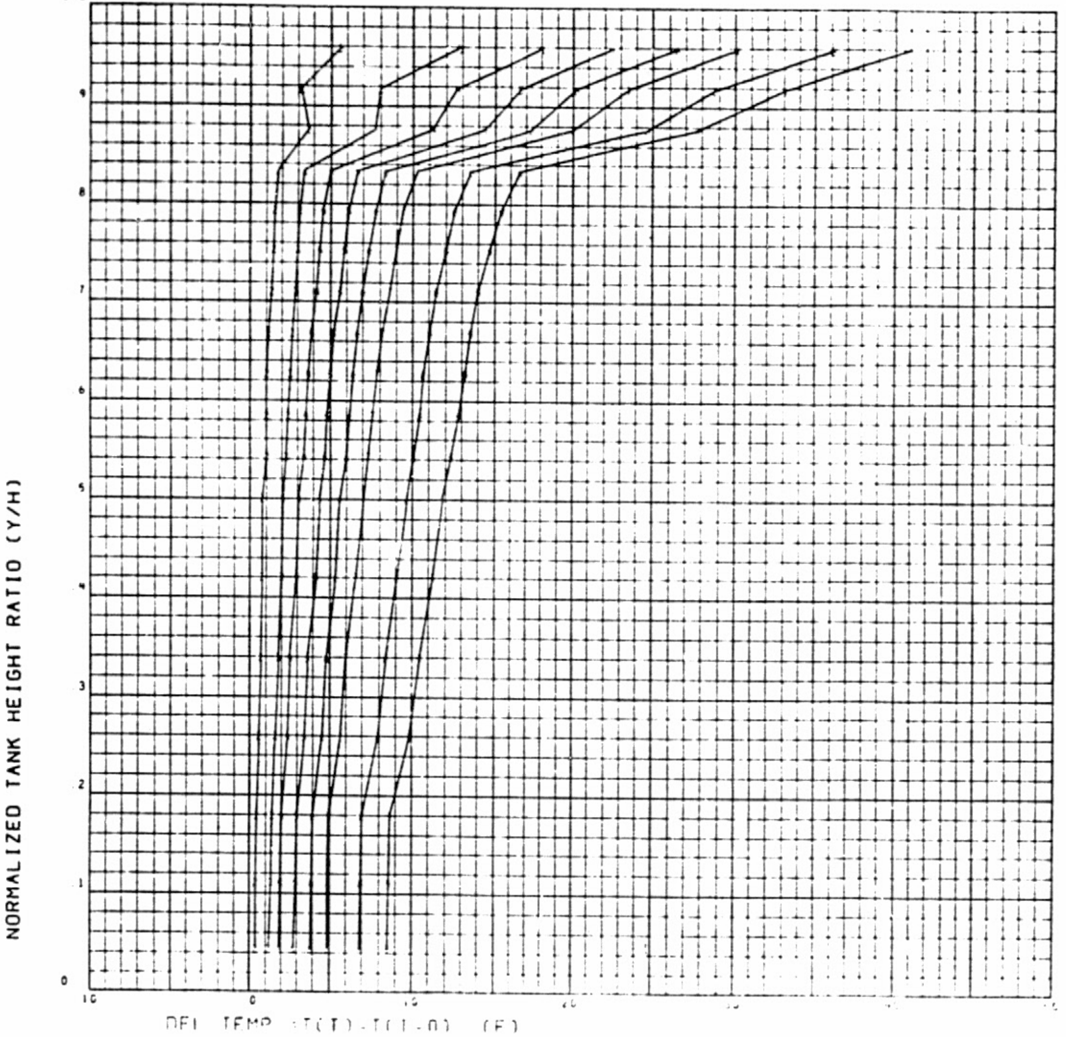


FIGURE 5.8-3a
6 IN. TNK TEST 8GΣ13 – STRAT DTNORM PROFILE

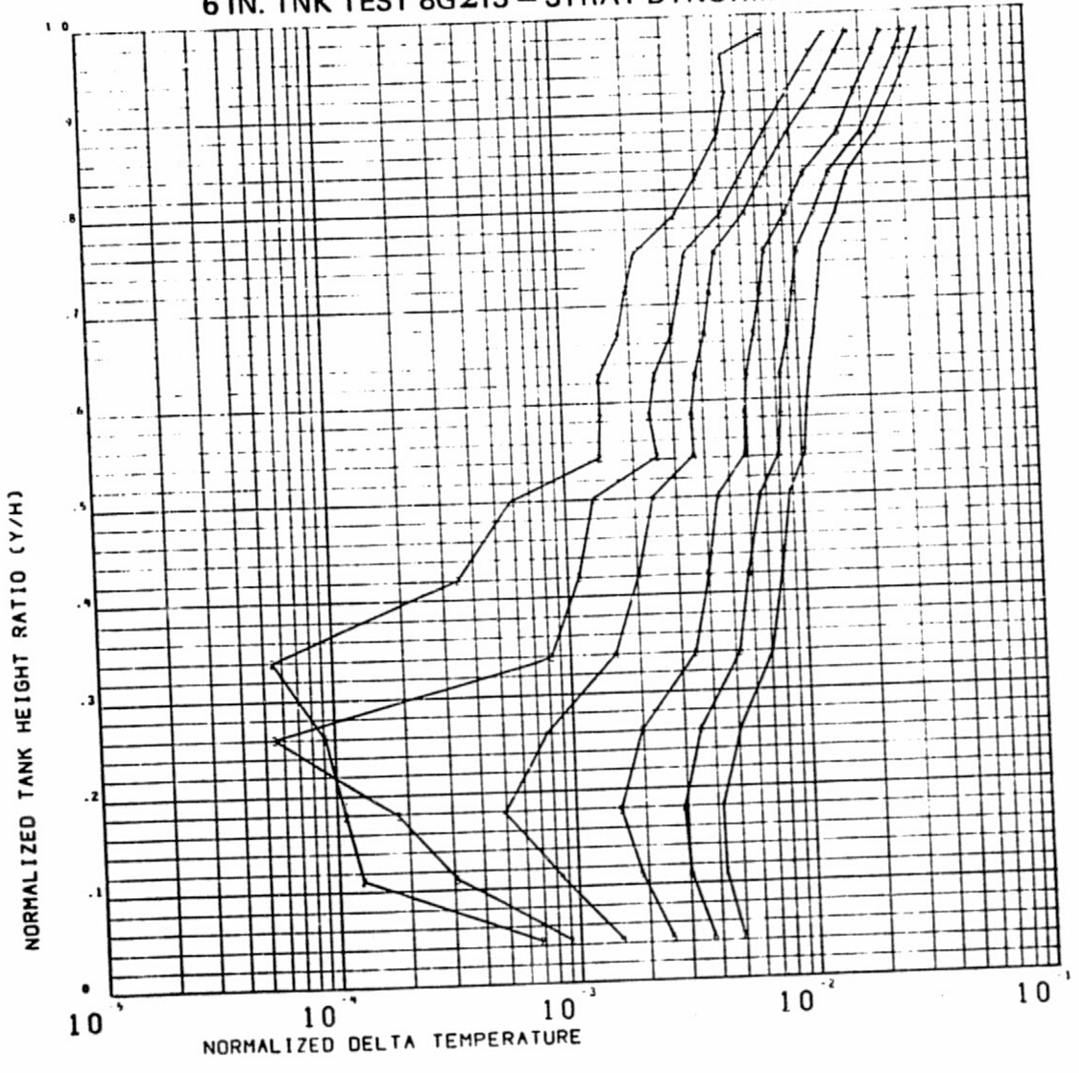


FIGURE 5.8-3b
12 IN. TNK TEST 1GΣ27 – STRAT DTNORM PROFILE

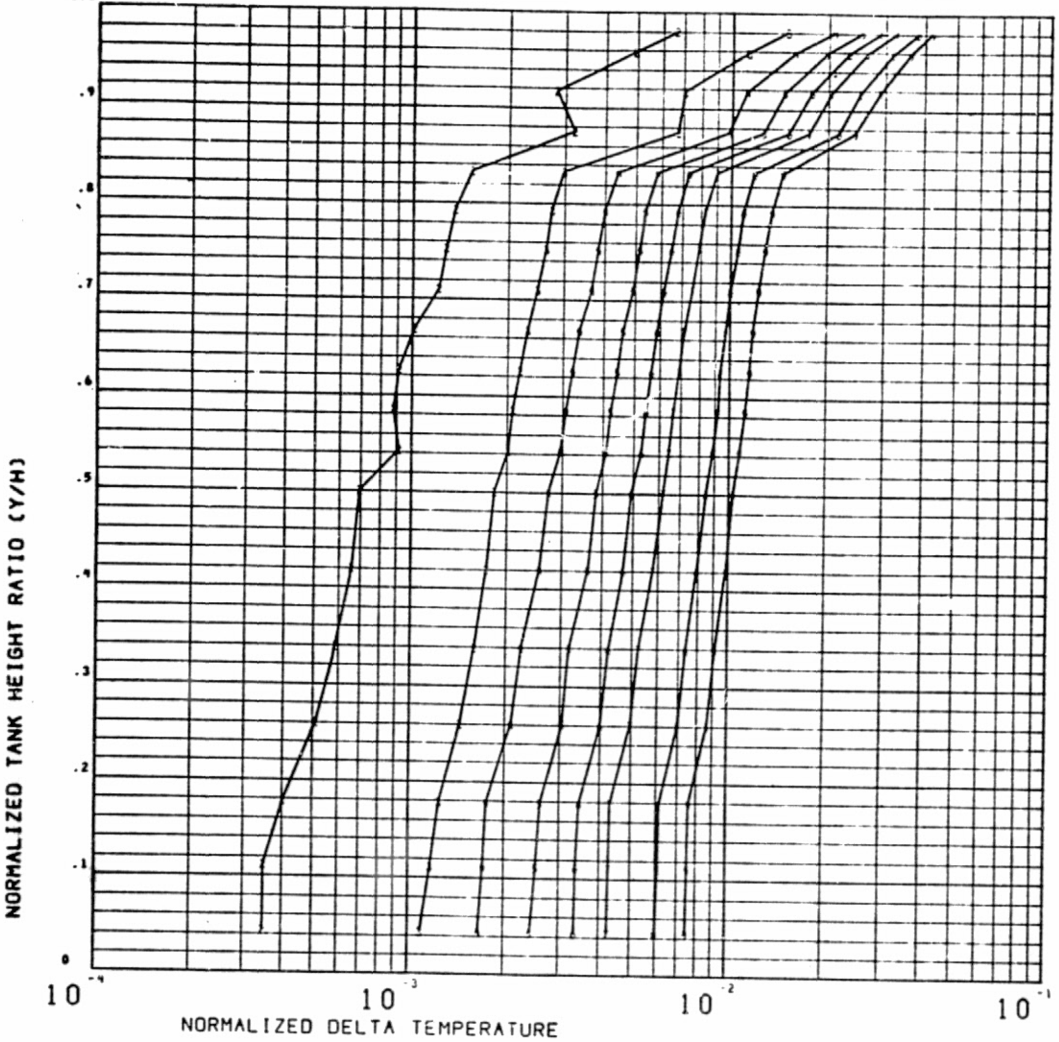


FIGURE 5.8-4a

6 IN. TNK TEST 8GΣ13 – BULK ULGE Y LIQ TEMP HISTORIES

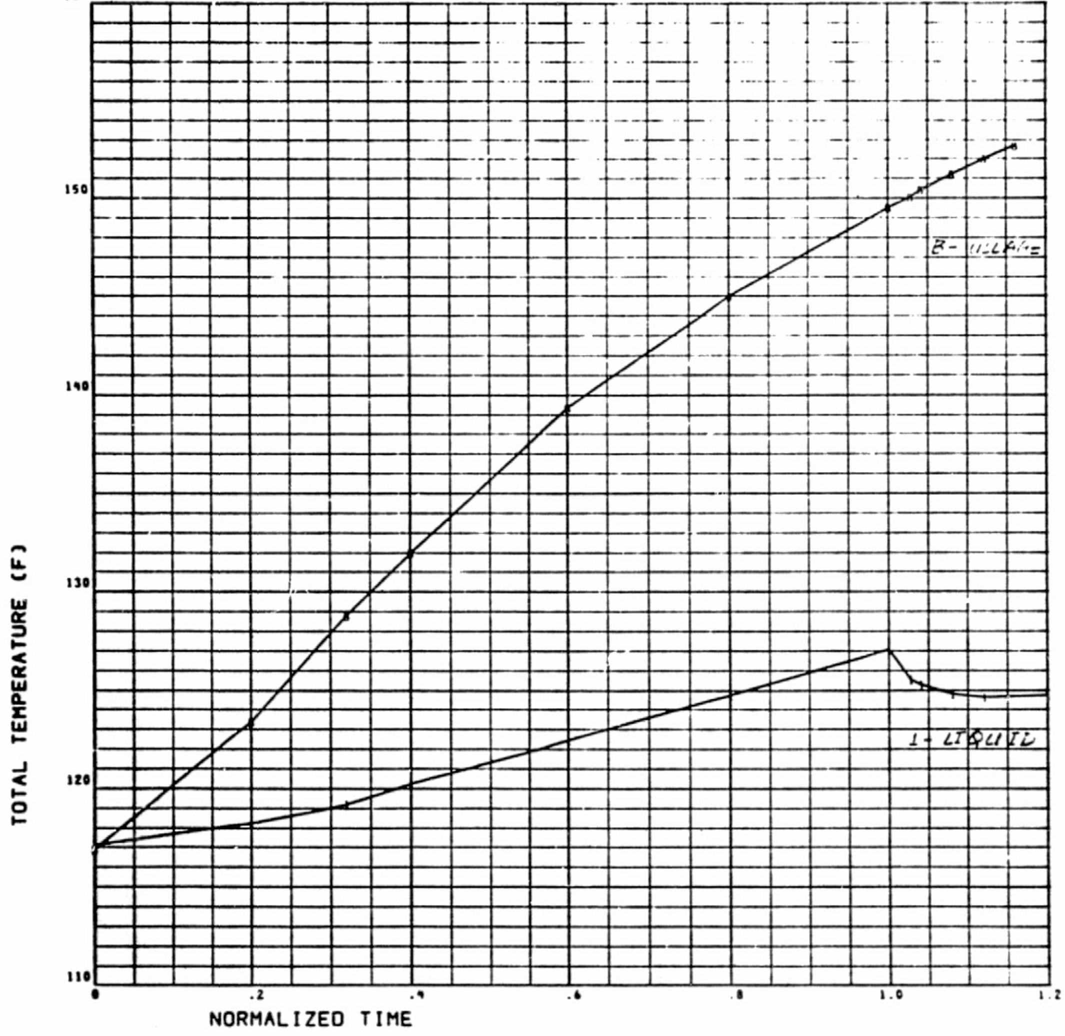


FIGURE 5.8-4b

12 IN. TNK TEST 1GΣ27 – BULK ULGE γ LIQ TEMP HISTORIES

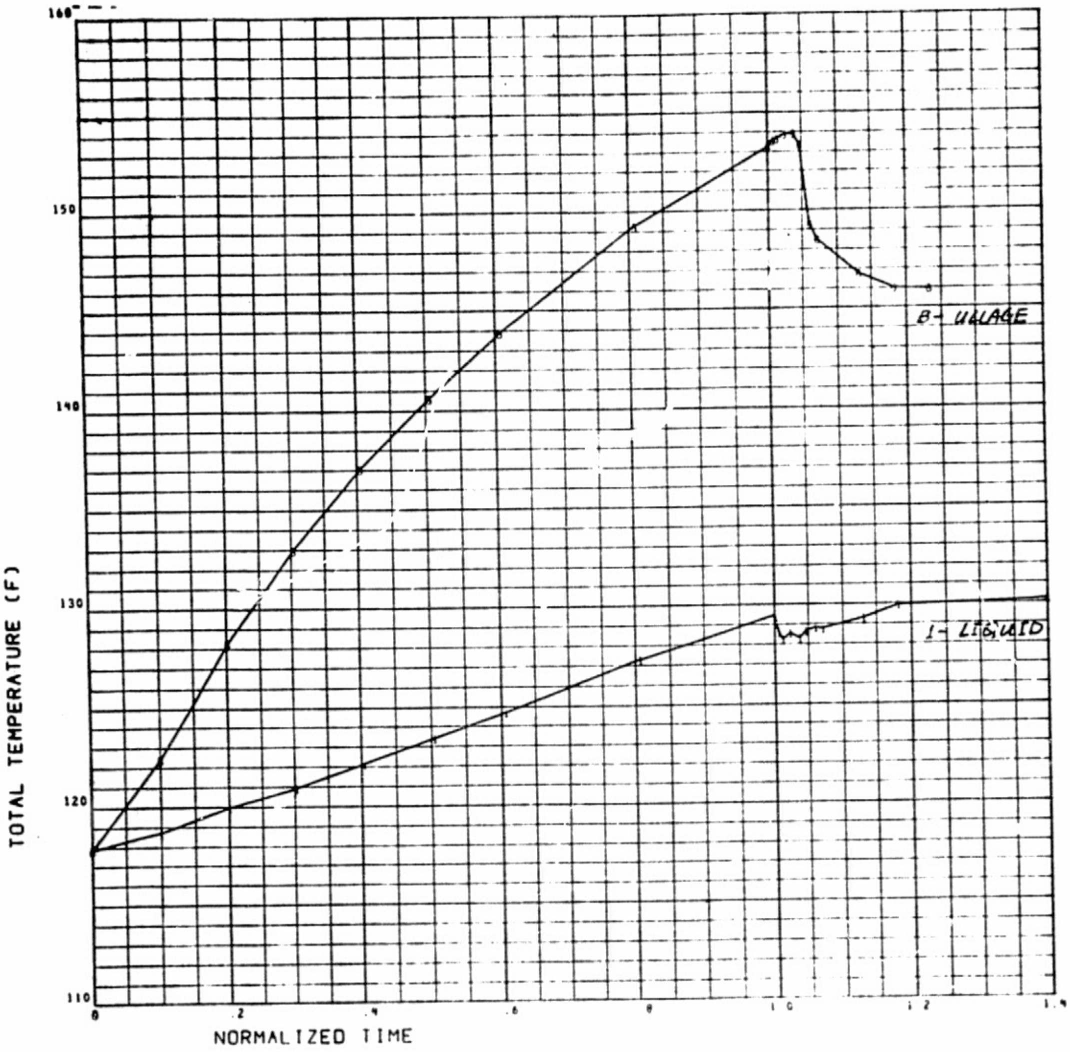


FIGURE 5.8-5a
6 IN. TNK TEST 8GΣ13 – TANK PRESSURE HISTORY

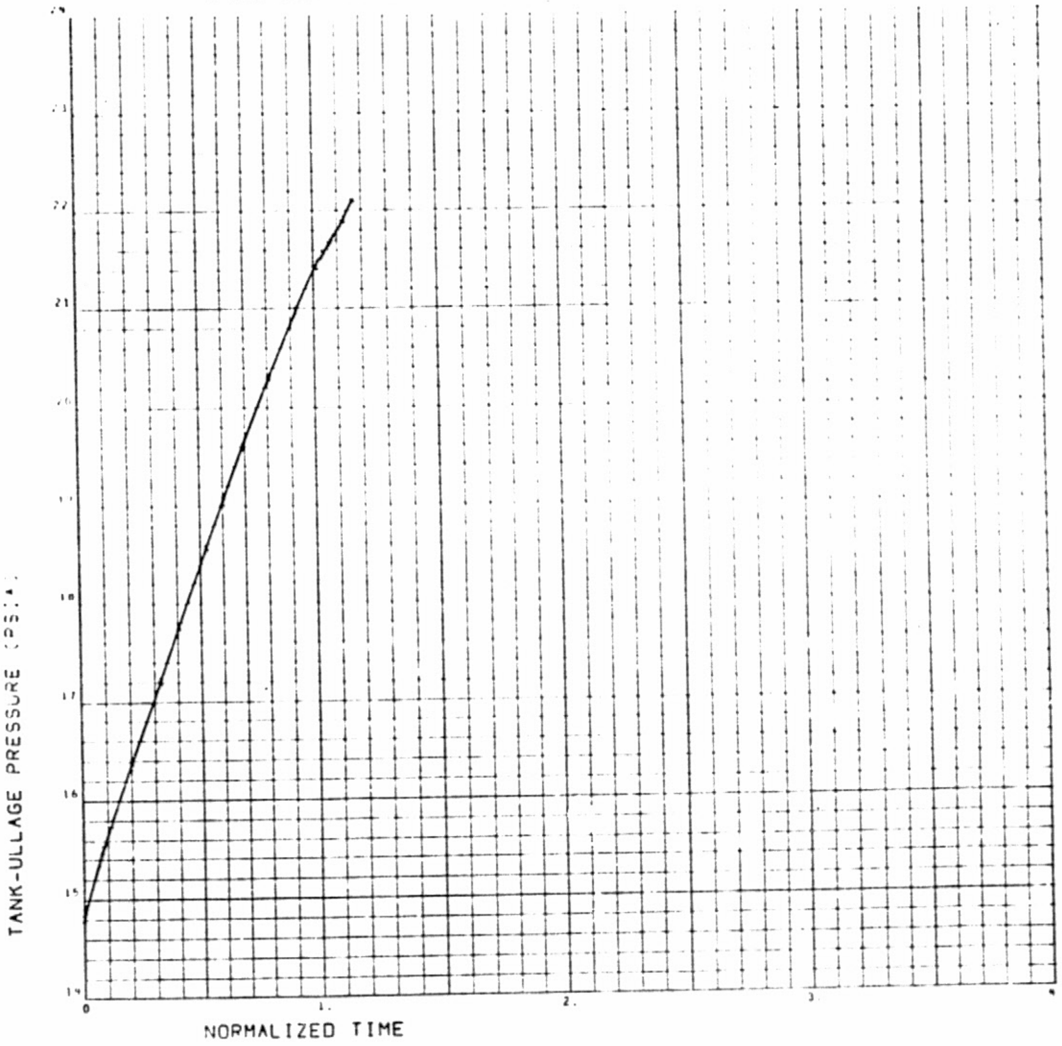
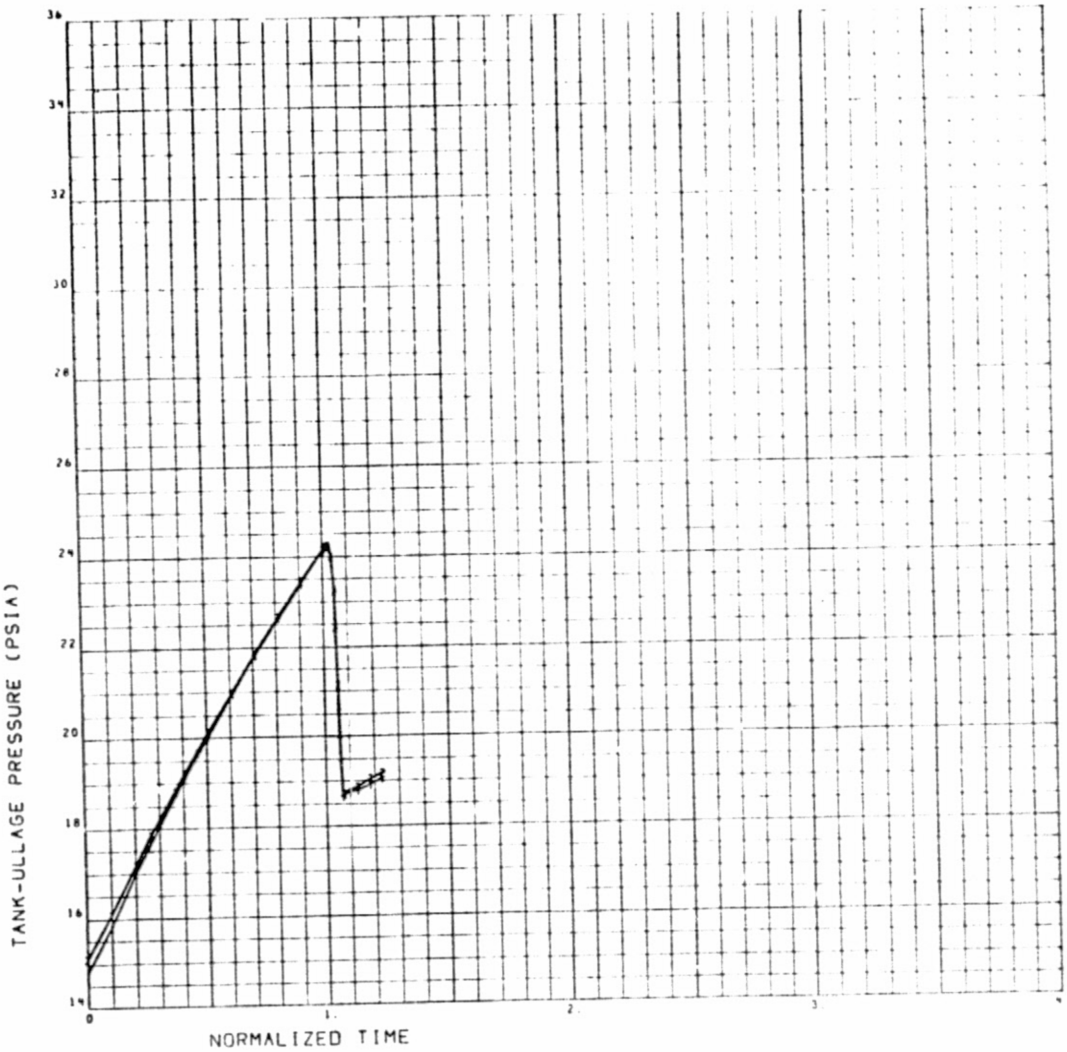


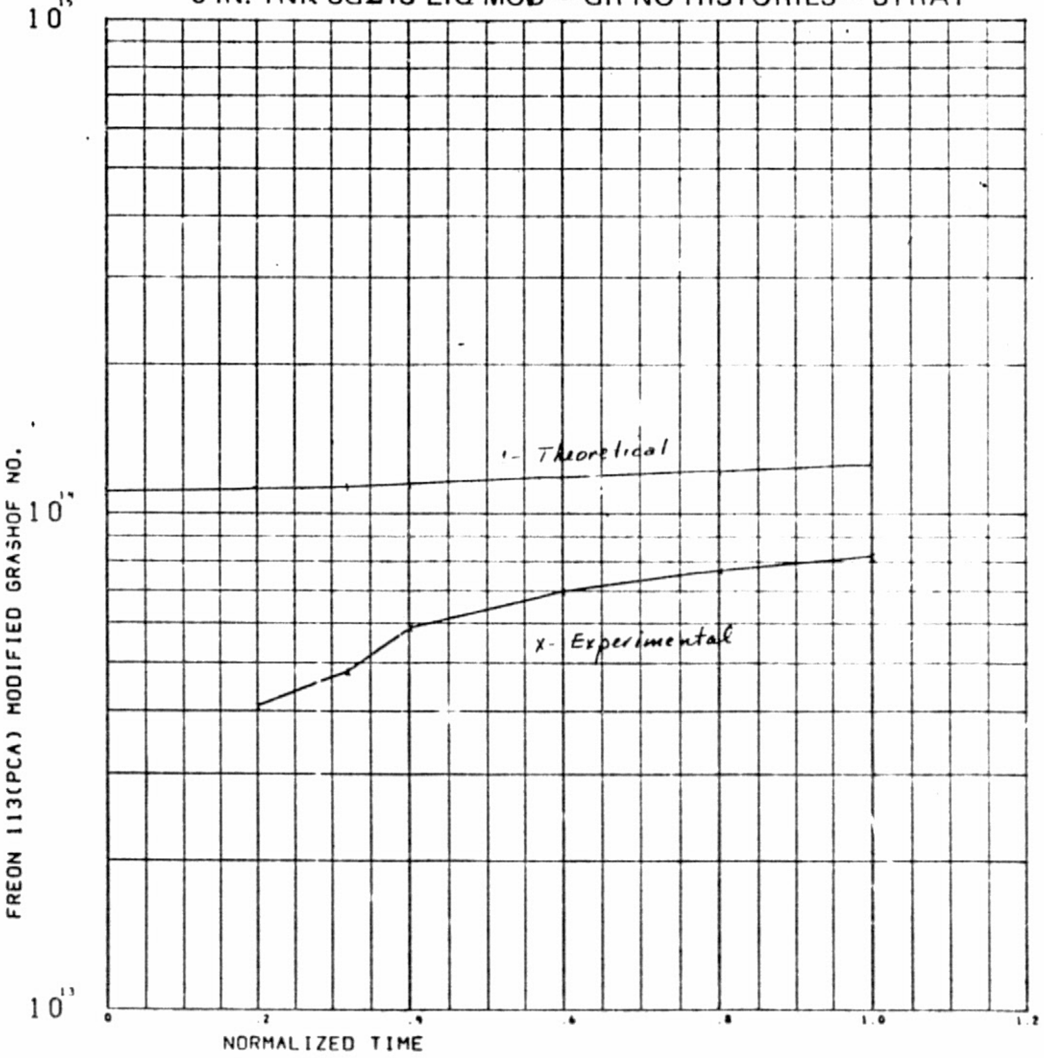
FIGURE 5.8-5b
12 IN. TNK TEST 1GΣ27 – TANK PRESSURE HISTORY



1 - Gage
2 }
3 } - Transducer

FIGURE 5.8-6a

6 IN. TNK 8GΣ13 LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

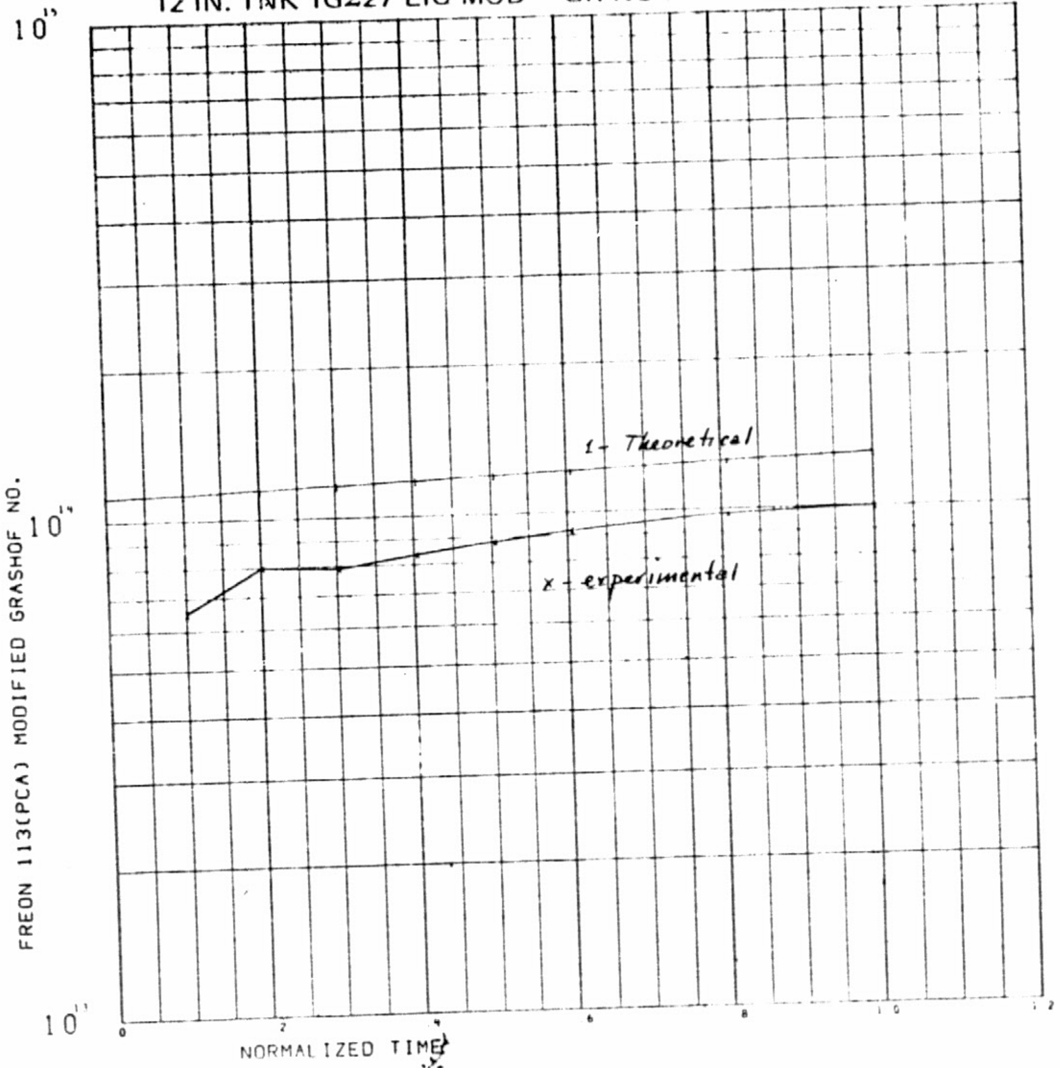
L = fluid depth.

I = Based on q''_{IN} wattage measured input

X = Based on experimentally determined; $q''_{fluid(\ell)}$

FIGURE 5.8-6b

12 IN. TNK 1GΣ27 LIO MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q''L}{k}\right)$$

1 = Based on q''_H wattage measured input

X = Based on experimentally determined; $q''_{fluid(l)}$

L = fluid depth

FIGURE 5.8-7a
6 IN. TNK 8GΣ13 LIQ FOURIER NO HISTORY

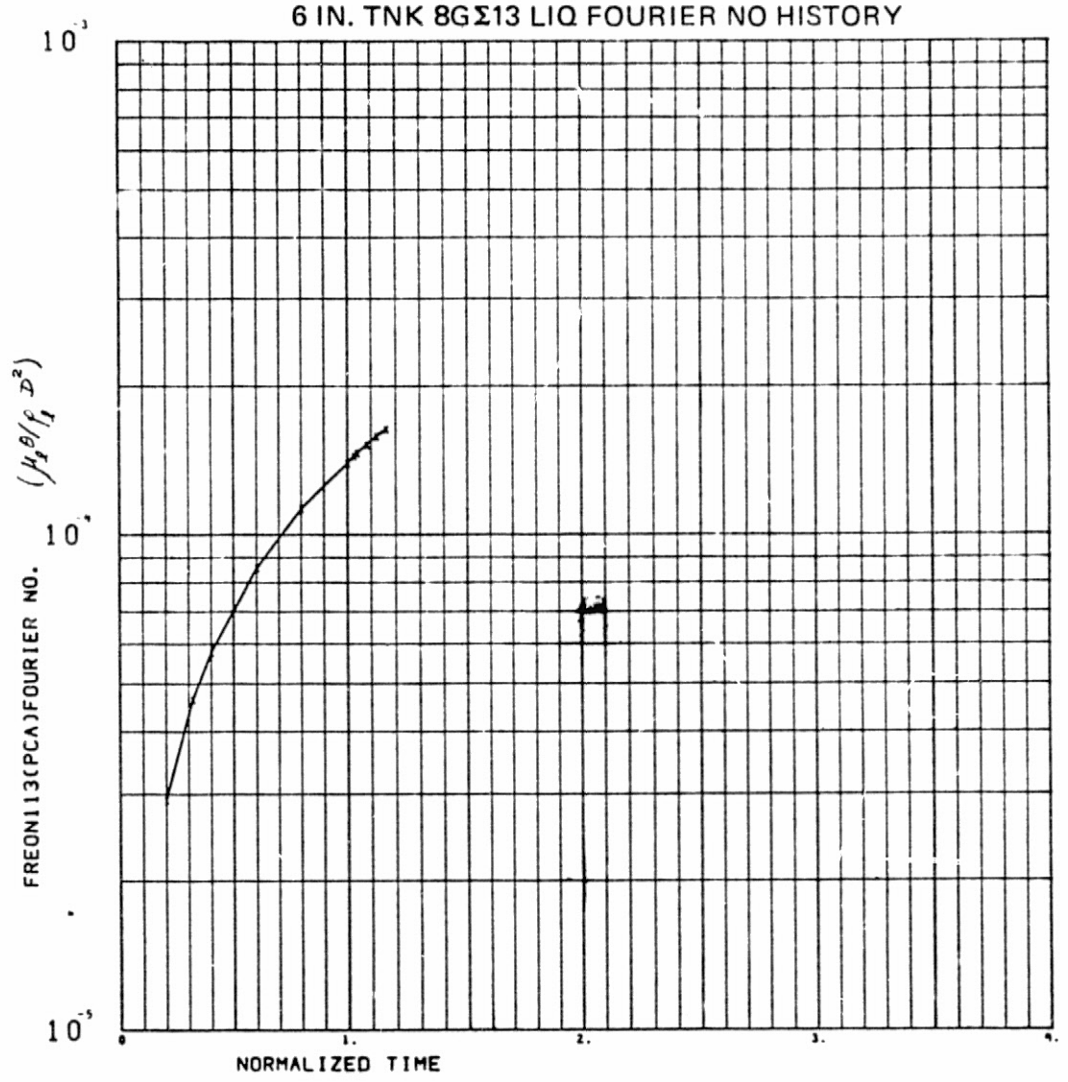
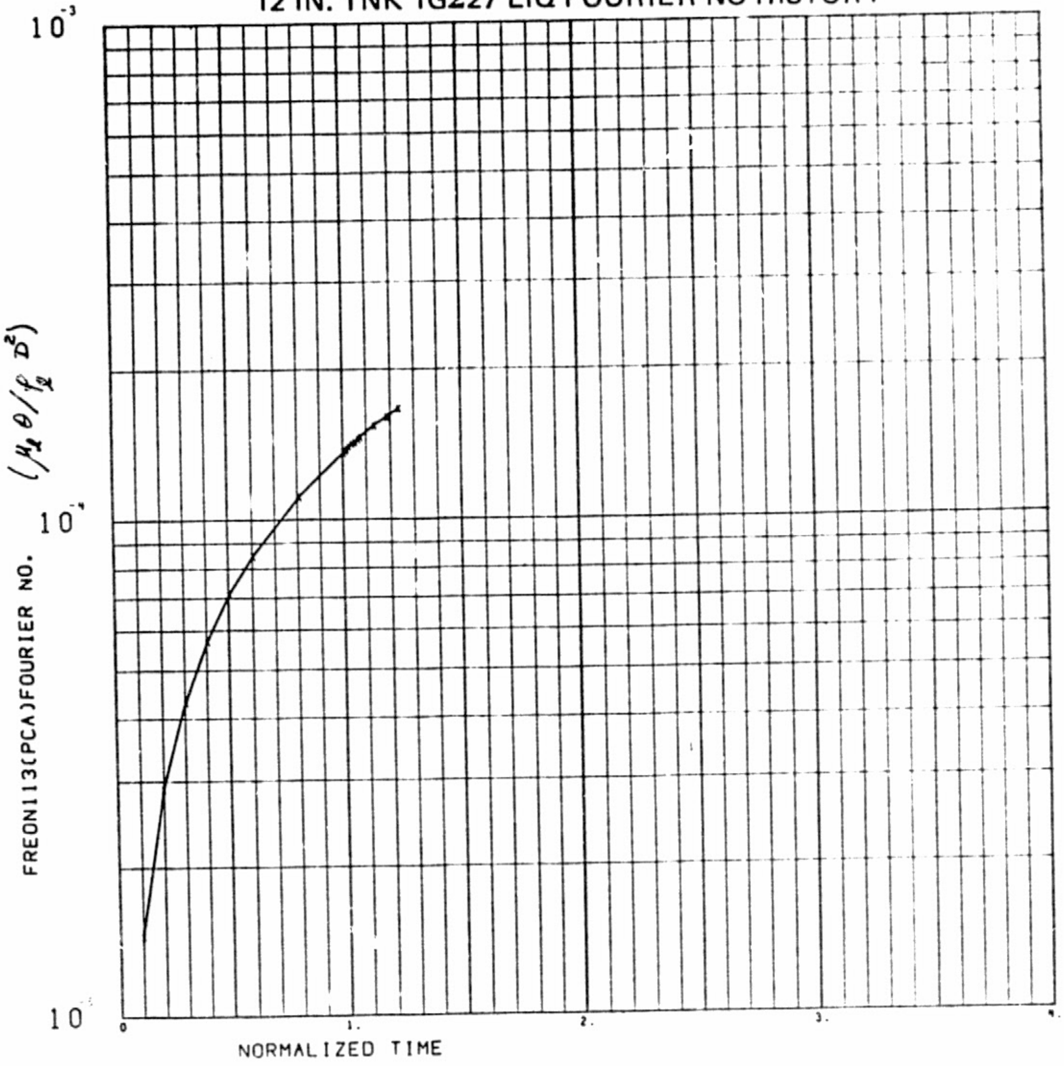


FIGURE 5.8-7b

12 IN. TNK IGΣ27 LIQ FOURIER NO HISTORY



Section 5.9

SCALING SET

6-in.-Dia Tank Test	18-in.-Dia Tank Tests
27G	1G
Test #1S	Test #BS Test #D

Table 5.9-1a. 6 IN. DIA. TANK TEST 27G#1S (Page 1 of 2)

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=   .3927      CYL AREA FT2=  1.5708      FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131     1/2 CYL WALL VOLFT3=   .00164    FLNGE VOL FT3=    .00076
DME MASS LBM=   .65596     MASS 1/2 CYL LBM=    .81996     FLANGE MASS=    .38058

 LIQ VOL FT3=   .13090      ULLAGE VOL FT3=   .13090

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56=2236.6858   H910=2236.6858   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)=2236.6858
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU=   43.917     (STRAT+DESTRAT)BTU=    0.000
EST.LIQ TEMP INCRSE(STRAT)=   15.7671F     (STRAT+DESTRAT)=    0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.9-1b. 18 IN. DIA. TANK TEST 1G#BS

```
          STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  3.5343      CYL AREA FT2= 14.1372      FLNGE AREA FT2=   .3281
DME WALL VOL FT3=   .03299     1/2 CYL WALL VOLFT3=   .04418    FLNGE VOL FT3=    .02058
DME MASS LBM= 16.53031     MASS 1/2 CYL LBM= 22.13880     FLANGE MASS= 10.27571

 LIQ VOL FT3=  3.53429      ULLAGE VOL FT3=  3.53429

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=   0.0000   H34=   0.0000   H56= 753.4729   H910= 752.5082   H78=   0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 753.1513
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=   0.0000
EST.HT INPUT LIQ(STRAT)BTU= 1197.835     (STRAT+DESTRAT)BTU=    0.000
EST.LIQ TEMP INCRSE(STRAT)=   15.9327F     (STRAT+DESTRAT)=    0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=    0.000      (STRAT+DESTRAT)BTU=    0.000
```

Table 5.9-1c. 18 IN. DIA. TANK TEST #D (Page 2 of 2)

```
STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS


DOME AREA FT2=  3,5343       CYL AREA FT2= 14,1372       FLNGE AREA FT2=    ,3281
DOME WALL VOL FT3=   ,03299      1/2 CYL WALL VOLFT3=     ,04418      FLNGE VOL FT3=    ,02051
DOME MASS LBM= 16,53031      MASS 1/2 CYL LBM= 22,13880      FLANGE MASS= 10,2757

LIQ VOL FT3=  3,53429        ULLAGE VOL FT3=  3,53429

INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=    0,0000    H34=    0,0000    H56= 753,4729    H910= 752,5082    H78=    0,0000

EST,HT FLUX IN LIQ (BTU/HR-FT2)= 753,1513
EST,HT'FLUX IN ULLGE (BTU/HR-FT2)=    0,0000
EST,HT INPUT LIQ(STRAT)BTU= 1197,835      (STRAT+DESTRAT)BTU= 2928,042
EST,LIQ TEMP INCRSE(STRAT)=    15,9339F      (STRAT+DESTRAT)=    38,8666F

EST,HT INPUT ULLAGE(STRAT)BTU=     0,000      (STRAT+DESTRAT)BTU=     0,000
```

Table 5.9-2a. 6 IN. DIA TANK TEST 27G #1S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

```
TIME(MIN)    0.000     .233     .484     .734     .967
TAU          0.000     .233     .484     .734     .967
 1         116.542  117.000  118.750  120.833  123.333
 2         116.625  117.125  118.875  121.292  123.625
 3         117.167  117.625  119.458  121.750  124.042
 4         116.938  119.229  122.958  126.083  128.979
 5         116.708  120.833  126.458  130.417  133.917
 6         117.042  122.708  129.250  133.667  137.375
 7         117.396  123.208  129.125  133.563  137.167
 8         117.750  123.708  129.000  133.458  136.958
 9         115.292  118.083  120.958  123.833  126.458
10         116.125  116.833  118.625  121.000  123.333
11         116.708  116.917  118.833  121.375  123.833
12         116.826  123.691  128.792  132.396  135.458
13         117.417  134.292  141.750  145.458  148.750
14         115.792  116.583  118.625  120.875  123.167
15         116.208  117.083  118.958  121.417  123.750
16         116.500  117.792  119.667  122.083  124.375
17         116.139  120.847  125.333  129.083  131.875
18         115,958  122.375  128.167  132.583  135.625
19         116.125  118.500  120.833  123.667  126.167
20         116.125  116.833  118.625  121.000  123.333
21         116.708  116.917  118.833  121.375  123.833
22         116.826  123.691  128.792  132.396  135.458
23         117.417  134.292  141.750  145.458  148.750
24         116.125  117.125  119.042  121.375  123.833
25         115.417  116.375  118.292  120.625  123.167
26         115.521  116.500  118.458  120.771  123.208
27         115.625  116.625  118.625  120.917  123.250
28         116.167  117.208  119.125  121.125  123.625
29         115.417  115.875  117.042  118.833  120.833
30         115.417  116.542  118.458  120.833  123.208
31         120.153  132.611  135.556  137.361  139.472
32         120.458  133.167  136.167  137.167  139.000
33         114.042  116.917  119.417  120.833  122.000
34         109.042  110.292  111.563  112.229  112.833
```

Table 5.9-2a. 6 IN. DIA TANK TEST 27G #1S (Page 2 of 2)

35	104.042	103.667	103.708	103.625	103.667
36	120.000	132.333	135.250	137.458	139.708
37	115.792	117.125	119.208	121.333	124.042
38	115.875	117.083	119.042	121.333	124.000
39	116.083	117.250	119.542	121.833	124.333
40	116.417	117.750	119.833	122.250	124.833
41	115.833	117.417	119.542	121.875	124.458
42	115.958	117.375	119.458	121.708	124.333
43	116.333	117.625	119.875	122.083	124.708
44	116.000	117.500	120.250	123.042	124.625
45	116.500	117.583	119.792	122.208	124.750
46	116.042	117.583	119.792	122.250	124.667
47	116.375	117.833	120.042	122.417	124.917
48	117.042	118.417	120.750	122.917	125.667
49	117.583	119.250	121.583	124.250	127.208
50	118.208	119.958	122.500	125.292	128.250
51	11[illegible].667	120.597	123.194	126.014	128.972
52	118.139	119.991	122.440	125.213	128.171
53	117.542	119.417	121.625	124.333	127.292
54	119.051	120.730	123.224	125.989	128.961
55	120.875	122.208	124.792	127.542	130.542
56	119.051	120.730	123.224	125.989	128.961
57	120.875	122.208	124.792	127.542	130.542
58	119.125	121.236	123.889	126.736	129.694
59	119.583	121.875	124.583	127.458	130.417
60	119.153	121.764	124.944	127.944	131.014
61	118.292	121.542	125.667	128.917	132.208
62	118.333	121.500	124.583	127.792	131.042
63	119.833	123.125	126.625	129.833	132.792
64	121.542	124.792	128.042	131.333	134.333
65	117.875	120.292	123.292	126.333	129.708
66	118.292	119.375	121.917	124.625	127.375
67	119.667	120.542	123.125	126.000	129.042
68	118.125	119.014	121.125	123.528	126.208
69	117.917	118.458	120.375	122.667	125.625
70	118.167	119.208	121.083	123.292	125.625
71	119.167	120.375	121.958	124.250	126.917
72	121.625	123.292	125.083	127.583	130.333
73	118.625	119.833	122.250	125.000	126.792
74	111.125	111.708	112.333	113.125	114.000
75	99.625	100.292	101.167	101.958	102.917
76	108.875	109.417	109.958	110.750	111.583
77	94.000	94.333	94.458	94.833	95.208

Table 5.9-2b. 18 IN. DIA TANK TEST 1G #BS (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	2.000	4.000	6.000	7.000	9.000
TAU	0.000	.222	.444	.667	.778	1.000
1	117.042	117.875	119.542	121.792	123.042	125.625
2	117.333	118.125	120.042	122.500	123.833	126.625
3	117.583	118.417	120.375	123.000	124.333	126.917
4	117.667	118.667	120.792	123.333	124.667	127.208
5	117.625	127.708	132.167	135.292	136.708	139.625
6	117.667	132.417	136.667	140.000	141.625	144.333
7	117.875	134.042	138.125	141.000	142.167	145.042
8	118.125	130.625	133.708	136.708	137.792	140.417
9	117.750	122.250	124.583	127.125	128.458	130.958
10	117.292	118.000	119.958	122.458	123.833	126.500
11	117.375	118.208	120.500	123.000	124.292	126.750
12	116.250	145.125	150.417	153.667	155.500	158.167
13	116.250	144.125	148.292	151.042	152.000	154.792
14	117.042	117.875	119.542	121.792	123.042	125.625
15	117.333	118.125	120.042	122.500	123.833	126.625
16	117.458	118.333	120.542	123.167	124.417	126.917
17	117.542	126.333	130.625	133.917	135.333	138.292
18	117.688	124.500	128.000	131.021	132.458	135.313
19	117.833	122.667	125.375	128.125	129.583	132.333
20	117.292	118.000	119.958	122.458	123.833	126.500
21	117.375	118.208	120.500	123.000	124.292	126.750
22	118.625	146.083	150.625	153.917	155.417	158.292
23	118.250	144.125	148.292	151.042	152.000	154.792
24	117.000	117.875	119.625	121.875	123.167	125.292
25	116.667	117.458	119.083	121.042	122.042	123.917
26	114.875	117.250	118.875	120.917	121.792	123.583
27	113.792	116.833	118.708	120.750	121.583	123.292
28	116.750	117.125	118.125	119.542	120.333	121.625
29	116.625	117.083	118.250	120.000	120.875	122.625
30	116.917	117.875	119.708	122.000	123.083	125.500
31	117.750	132.708	136.792	139.667	141.125	143.333
32	116.500	137.708	141.750	144.500	145.875	148.458
33	113.708	120.917	124.625	127.083	128.292	130.667
34	111.333	114.854	116.771	118.167	118.833	120.146

Table 5.9-2b. 18 IN. DIA TANK TEST 1G #BS (Page 2 of 2)

35	108.958	108.792	108.917	109.250	109.375	109.625
36	118.625	136.500	140.292	143.125	144.542	147.063
37	116.708	117.625	119.063	121.000	122.000	123.833
38	116.750	117.708	119.500	121.625	122.833	124.958
39	117.125	118.125	119.958	122.333	123.458	125.792
40	117.417	118.375	120.292	122.500	123.708	126.083
41	116.458	117.125	119.375	122.167	123.417	126.000
42	117.250	118.167	120.042	122.625	123.750	126.375
43	117.292	118.292	120.208	122.542	123.917	126.417
44	117.583	118.625	120.417	122.917	124.167	126.708
45	117.292	118.292	120.125	122.500	123.833	126.417
46	117.292	118.292	120.125	122.708	124.000	126.542
47	117.542	118.542	120.458	122.833	124.083	126.750
48	117.625	118.667	120.708	123.125	124.333	127.083
49	117.750	118.375	120.417	122.750	124.292	126.958
50	117.458	118.417	120.417	123.042	124.500	127.250
51	117.500	118.625	120.417	122.958	124.500	127.167
52	117.417	118.458	120.333	122.833	124.417	127.167
53	117.375	118.375	120.250	122.875	124.667	127.500
54	117.542	118.542	120.438	122.938	124.563	127.250
55	117.625	118.583	120.333	122.875	124.417	127.167
56	117.667	118.625	120.542	123.042	124.708	127.333
57	117.625	118.500	120.333	123.000	124.583	127.250
58	117.667	118.750	120.542	122.917	124.417	127.042
59	117.500	118.542	120.500	123.000	124.563	127.167
60	117.458	118.292	120.083	122.458	124.083	126.833
61	118.208	119.875	121.750	124.083	125.458	126.000
62	118.167	119.542	122.000	124.500	126.000	128.958
63	118.083	119.417	121.625	124.208	126.083	128.833
64	118.146	118.979	120.875	123.146	124.583	127.396
65	118.042	118.625	120.625	122.708	124.542	127.208
66	118.125	118.417	119.750	121.792	123.167	125.833
67	117.958	117.958	118.958	120.833	122.250	124.708
68	118.000	117.875	119.083	121.042	122.500	125.083
69	117.958	118.000	119.292	121.542	122.792	125.375
70	118.167	117.958	118.958	120.625	121.833	124.375
71	118.000	117.792	118.625	120.458	121.958	124.500
72	117.875	118.125	120.000	122.375	123.958	126.375
73	117.917	118.792	119.958	122.833	124.125	126.875
74	85.750	85.667	85.542	85.583	85.875	86.000
75	94.333	94.333	94.125	94.292	94.708	94.875
76	84.042	83.833	83.667	83.667	84.000	84.125
77	94.417	94.208	94.083	94.167	94.500	94.708

Table 5.9-2c. 18 IN. DIA TANK TEST 1G #D (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

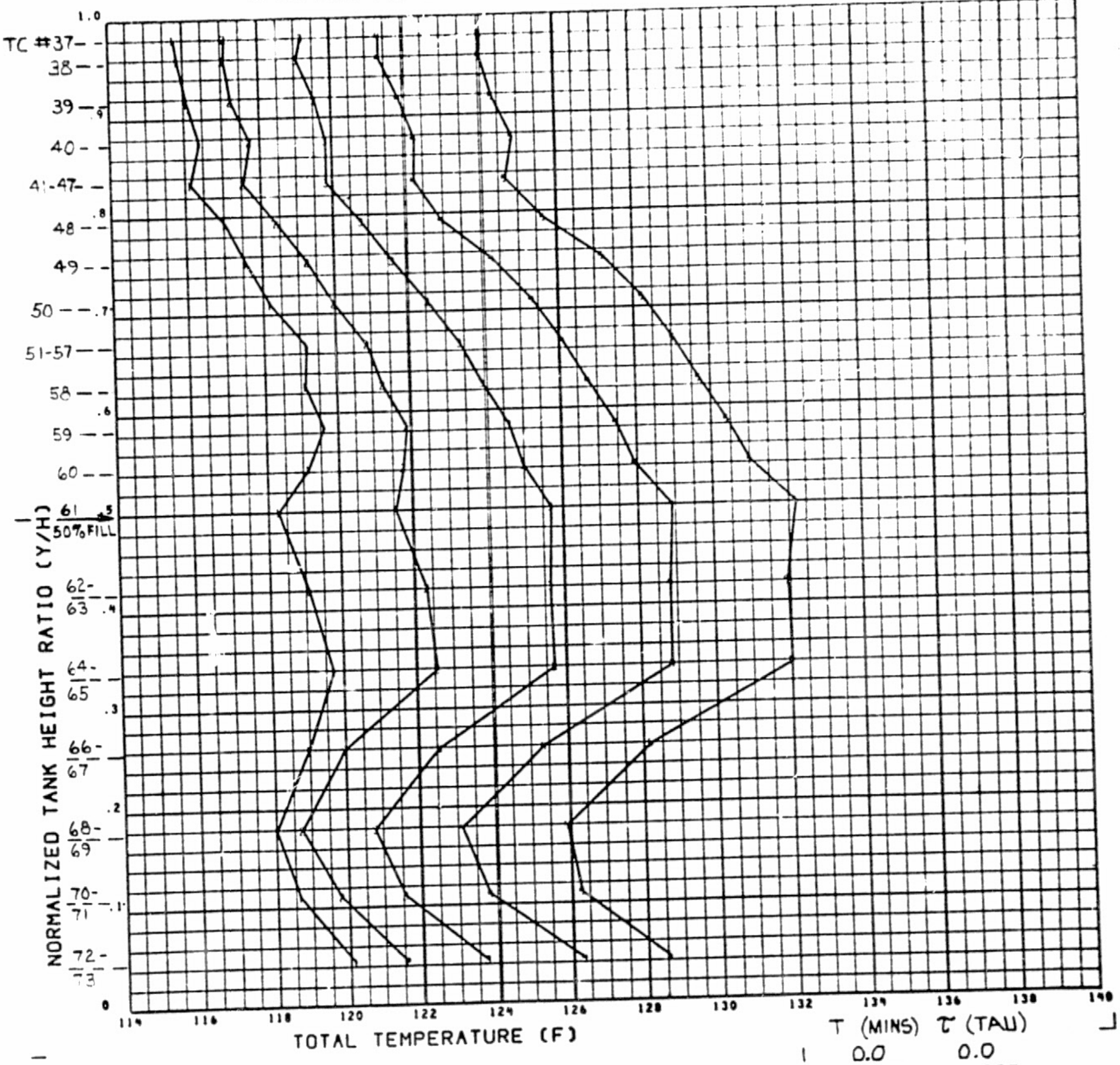
TIME(MIN)	0,000	2,000	4,000	7,000	9,000
TAU	0,000	,222	,444	,778	1,000
1	114,250	114,917	116,583	120,167	123,250
2	115,292	116,125	118,042	122,229	125,229
3	116,333	117,333	119,500	124,292	127,208
4	117,292	118,167	120,625	124,708	127,542
5	117,042	126,625	131,333	136,375	139,250
6	117,208	131,708	136,167	140,875	144,125
7	117,417	133,292	137,125	141,250	144,333
8	117,500	129,667	133,167	136,833	139,750
9	117,167	121,542	123,833	127,583	130,333
10	115,417	116,292	118,375	122,708	126,250
11	116,875	117,708	120,250	124,292	127,042
12	117,625	144,625	150,208	154,917	157,917
13	117,625	144,167	148,125	152,042	154,458
14	114,250	114,917	116,583	120,167	123,250
15	115,417	116,375	118,542	122,917	126,583
16	116,917	117,875	120,458	124,542	127,292
17	116,958	125,667	130,000	134,750	137,792
18	117,500	129,667	133,167	136,833	139,750
19	117,083	122,042	124,542	128,625	131,417
20	115,417	116,292	118,375	122,708	126,250
21	116,875	117,708	120,250	124,292	127,042
22	117,625	144,625	150,208	154,917	157,917
23	117,625	144,167	148,125	152,042	154,456
24	113,167	113,667	115,000	117,500	119,292
25	112,333	112,500	113,333	114,458	115,292
26	111,958	111,750	111,875	112,375	112,583
27	111,625	111,208	110,917	110,583	110,458
28	112,500	112,625	112,917	113,583	114,125
29	112,500	112,583	113,042	114,125	114,833
30	112,958	113,583	115,083	117,542	119,333
31	117,125	132,042	136,125	139,625	142,542
32	118,167	136,667	140,250	143,875	147,042
33	116,417	122,458	125,208	128,250	130,500
34	115,146	118,021	119,375	120,917	122,167

Table 5.9-2c. 18 IN. DIA TANK TEST 1G #D (Page 2 of 2)

35	113,875	113,583	113,542	113,583	113,833
36	118,042	136,250	139,792	143,625	146,542
37	113,042	113,125	113,625	114,708	115,625
38	113,375	113,542	114,250	116,083	117,333
39	113,833	114,042	115,375	117,875	119,583
40	114,208	114,708	116,167	118,833	121,000
41	114,333	114,875	116,458	119,625	122,333
42	114,375	115,167	116,792	120,333	123,250
43	114,542	115,208	116,958	120,333	123,208
44	114,542	115,417	117,083	120,625	123,375
45	114,292	115,083	116,875	120,417	123,250
46	114,292	115,250	117,042	120,667	123,583
47	114,417	115,542	117,417	121,208	124,250
48	115,250	116,333	118,333	122,750	126,250
49	115,542	116,667	118,833	123,250	126,833
50	116,042	117,292	119,375	124,083	127,292
51	116,417	117,625	119,833	124,583	127,333
52	116,250	120,458	119,750	124,667	127,375
53	116,250	117,333	119,708	124,583	127,417
54	116,319	119,542	119,819	124,667	127,431
55	116,375	117,542	119,750	124,583	127,458
56	116,458	117,708	119,958	124,667	127,542
57	116,333	117,625	119,875	124,708	127,417
58	116,917	117,958	120,375	124,542	127,333
59	116,792	118,083	120,583	124,583	127,417
60	116,750	118,333	120,458	124,208	126,875
61	117,167	119,208	121,250	124,208	127,042
62	117,458	119,125	121,458	125,542	128,333
63	117,167	118,875	121,208	125,208	128,042
64	117,347	118,389	120,222	124,028	126,764
65	117,167	118,125	120,000	124,000	126,792
66	117,417	117,917	119,208	122,542	125,167
67	117,250	117,500	118,500	121,625	124,083
68	117,125	117,375	118,500	121,875	124,542
69	117,250	117,542	118,750	122,208	124,958
70	117,375	117,542	118,417	121,167	123,667
71	117,208	117,292	118,125	121,333	123,750
72	117,042	118,042	119,542	123,125	126,083
73	117,125	118,042	119,792	123,333	126,458
74	86,167	86,292	86,042	86.083	86,167
75	94,042	94,167	93,958	94.042	94,250
76	84,958	84,958	84,792	84.917	84,917
77	95.625	95.667	95.500	95.583	95.667

FIGURE 5.9 1a

6 IN. TNK TST 27GΣ'S -- STRAT TEMPERATURE PROFILE

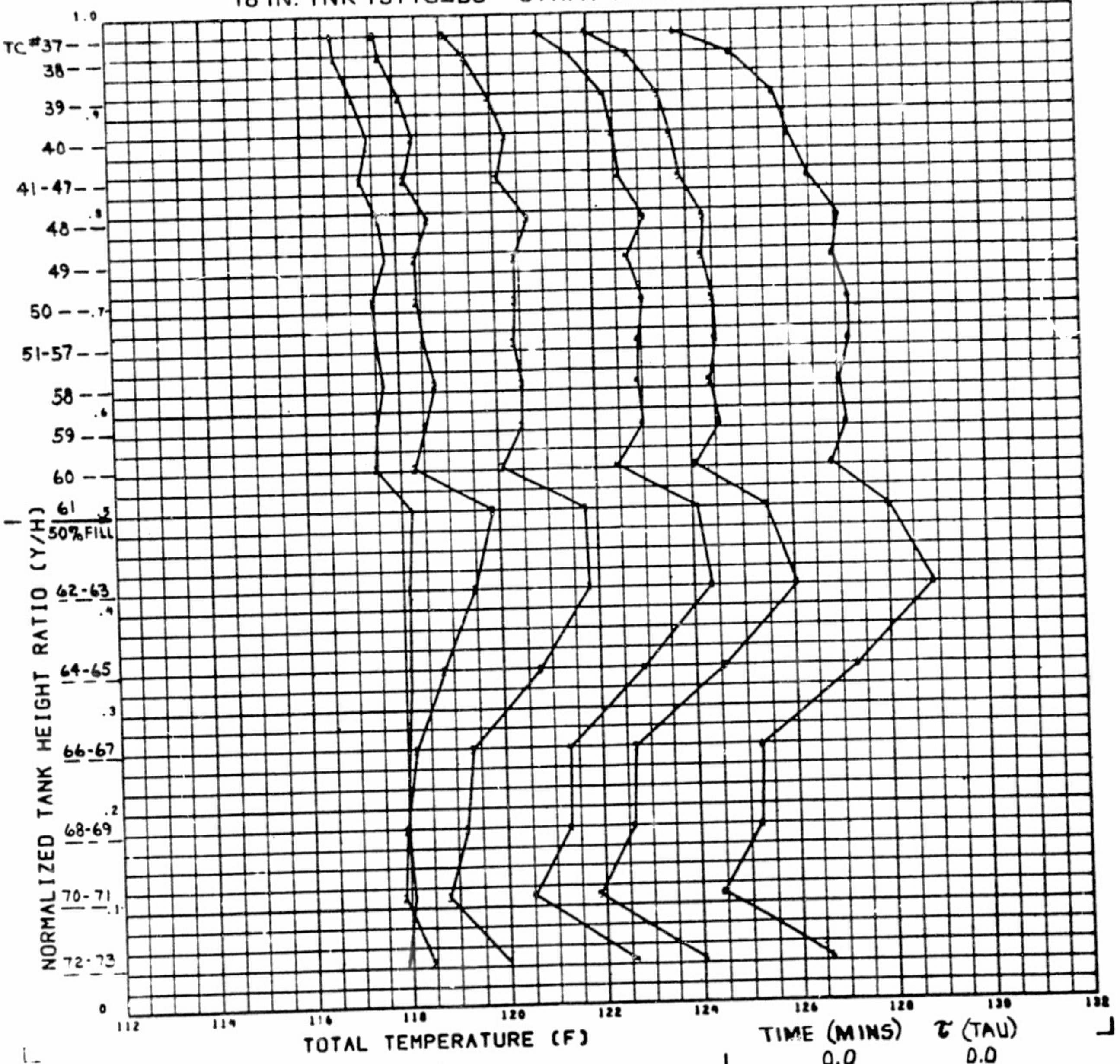


	T (MINS)	τ (TAU)
1	0.0	0.0
2	.233	.233
3	.484	.484
4	.734	.734
5	.967	.967

q''_H =22[illegible] BTU/HR FT^2 LIQ HT'G ONLY

FIGURE 5.9-1b

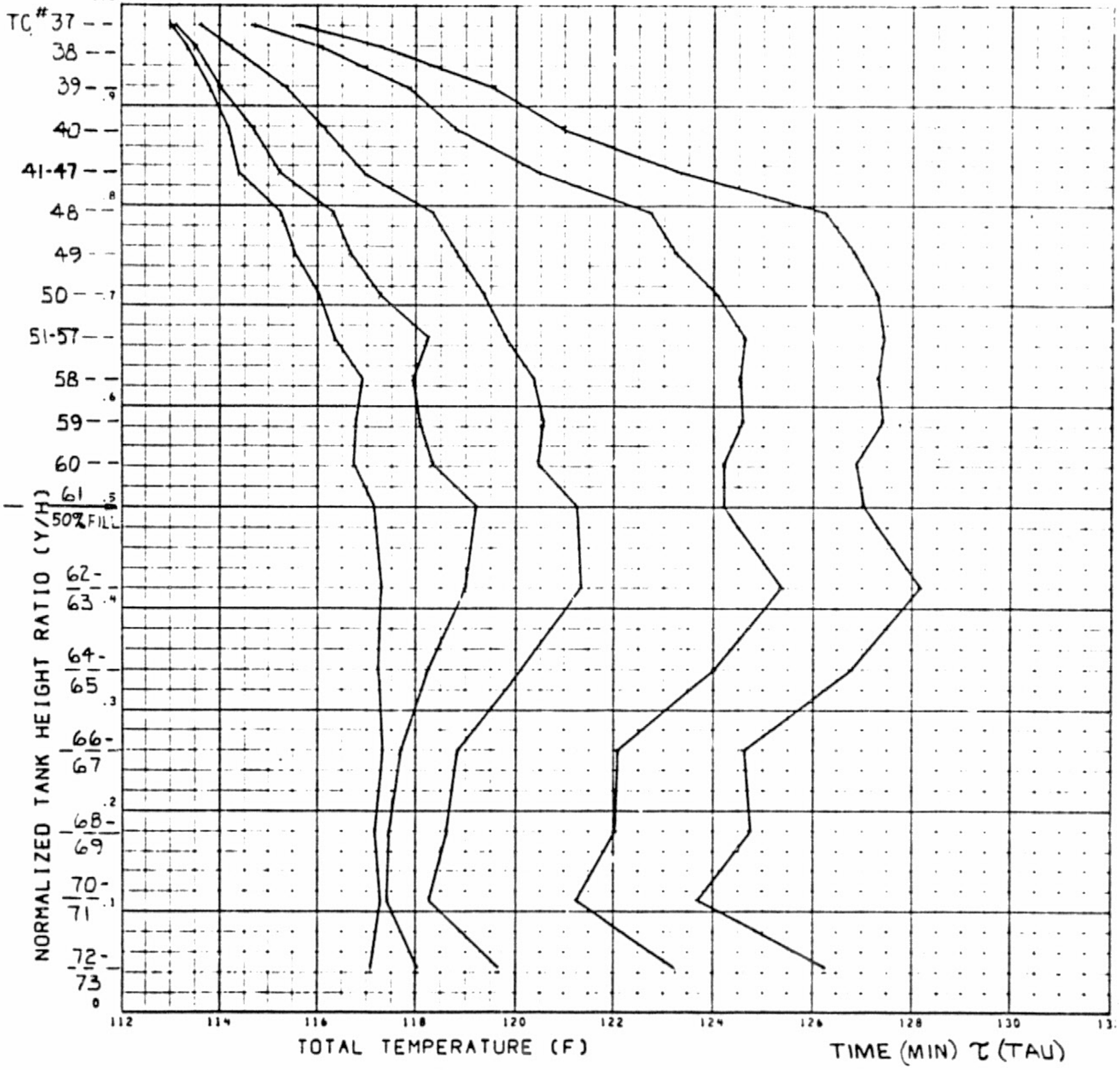
18 IN. TNK TST1GΣBS – STRAT TEMPERATURE PROFILE



BTU/HR FT LIQ HT'G

	TIME (MINS)	τ (TAU)
1	0.0	0.0
2	2.0	.222
3	4.0	.444
4	6.0	.667
5	7.0	.778
6	9.0	1.000

FIGURE 5.9-1c
18 IN. TNK TEST 1GΣD – STRAT TEMPERATURE PROFILE



q''_{BH} = 748 BTU/HR FT^2 LIQ HT'G ONLY

	TIME (MIN)	τ (TAU)
1	0.	0.
2	2.	.222
3	4.	.444
4	7.	.778
5	9.	1.000

FIGURE 5.9-2a

6 IN. TNK TST 27GΣ1S – STRAT DEL – TEMP PROFILE

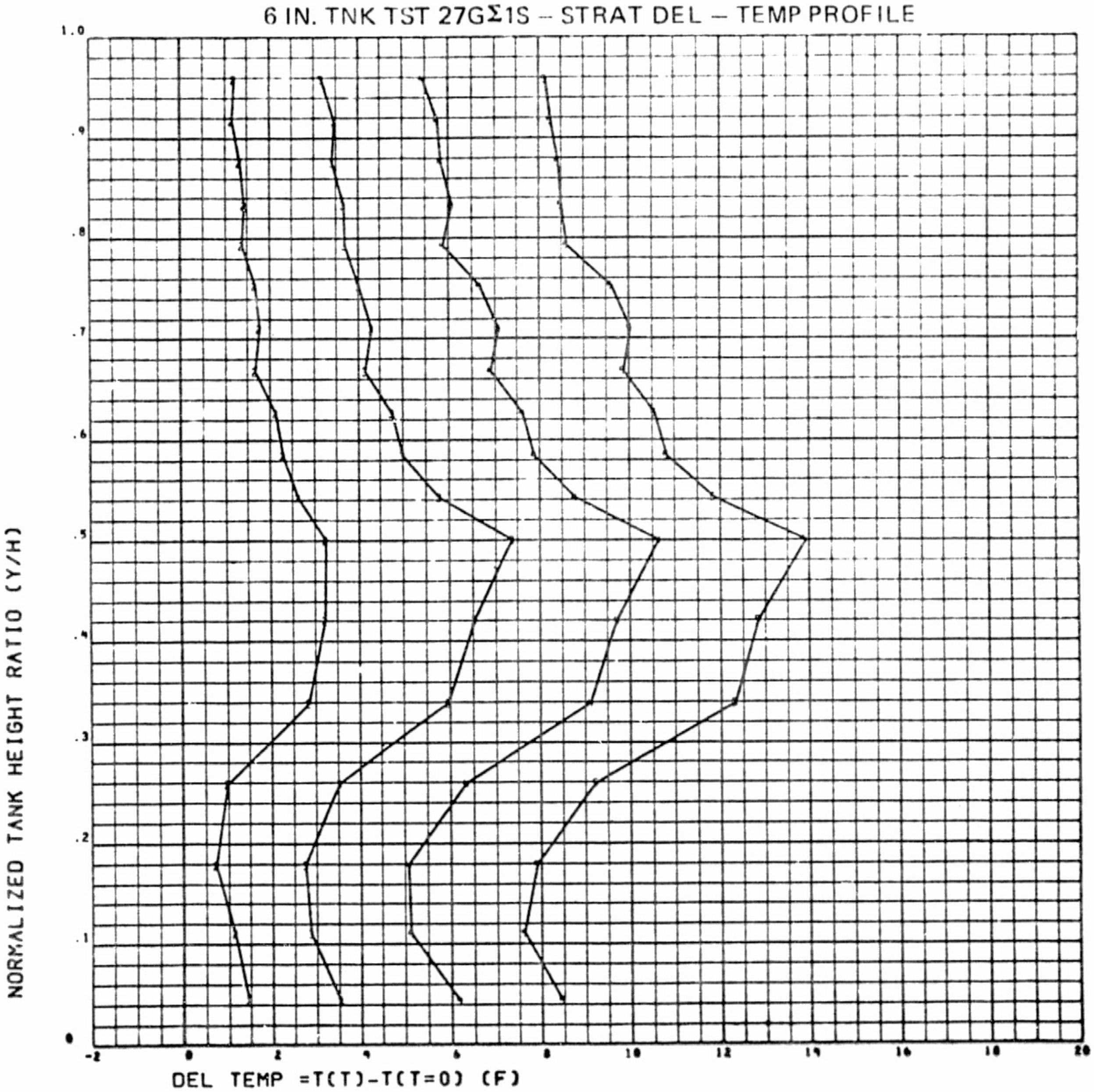


FIGURE 5.9-2b

18 IN. TNK TST 1GΣBS STRAT DEL – TEMP PROFILE

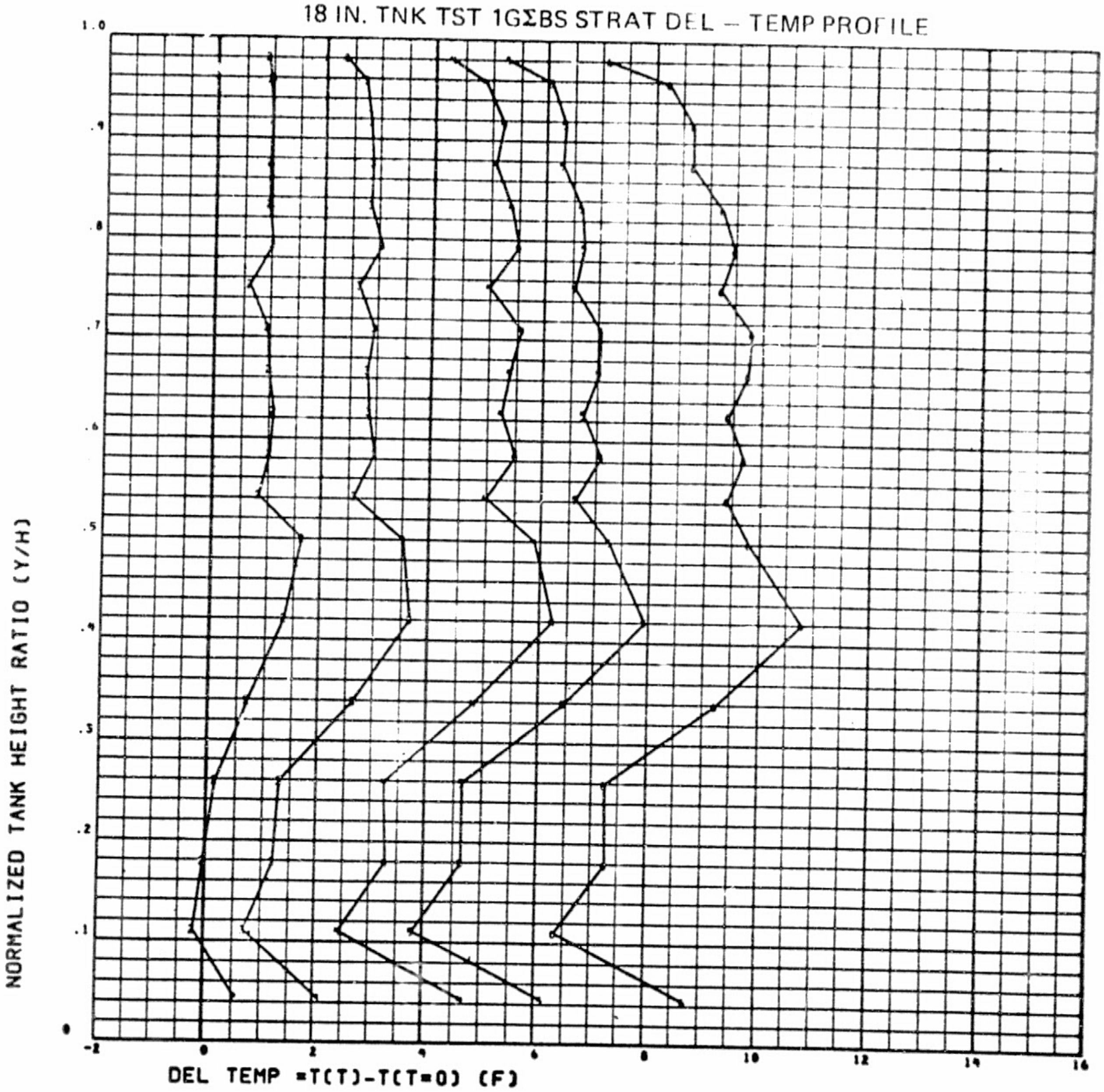


FIGURE 5.9.2c

18 IN. TNK TST 1GΣD STRAT DEL - TEMP PROFILE

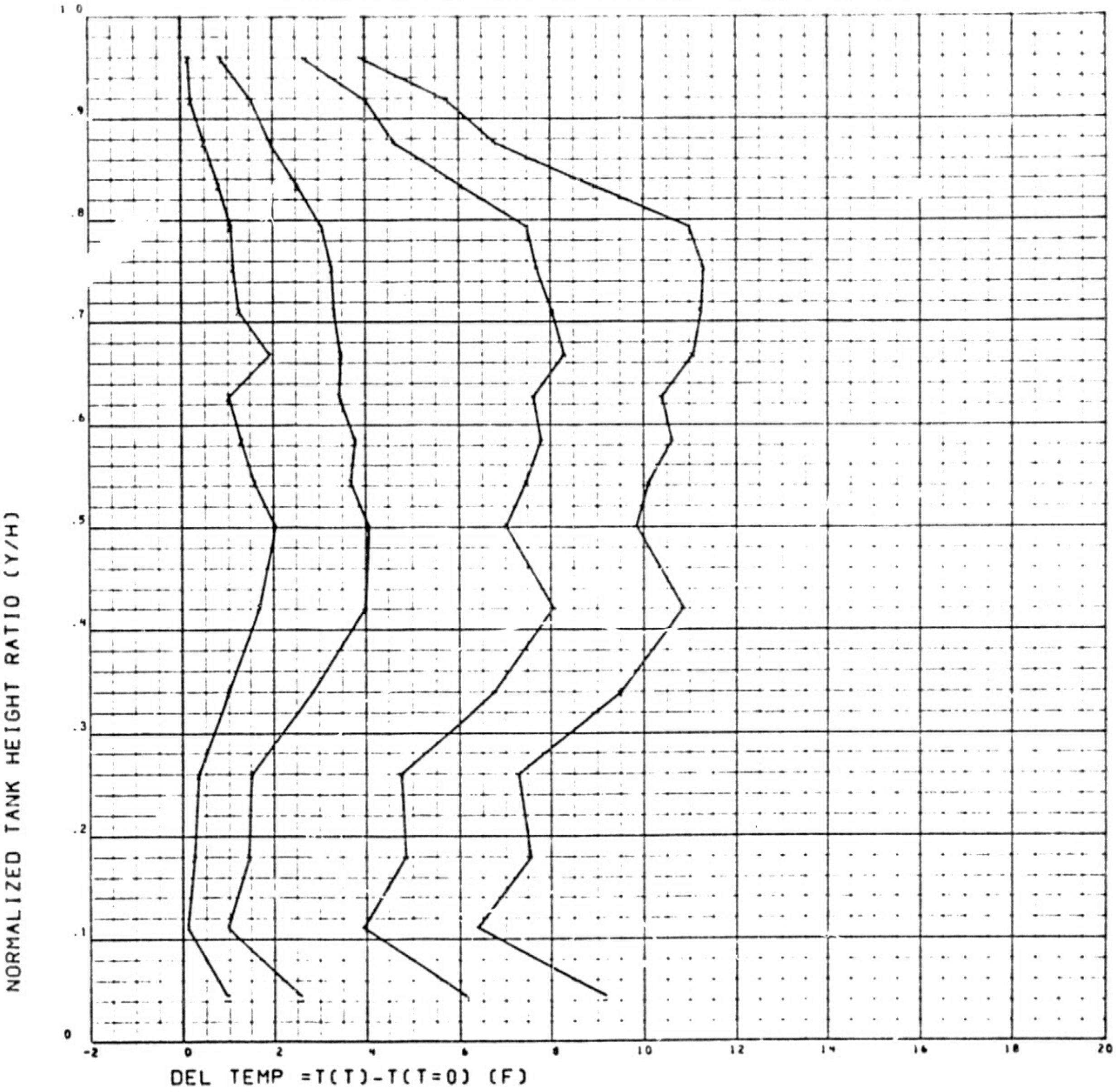


FIGURE 5.9.3a

6 IN. TNK TST 27G215 STRAT DTNORM PROFILE

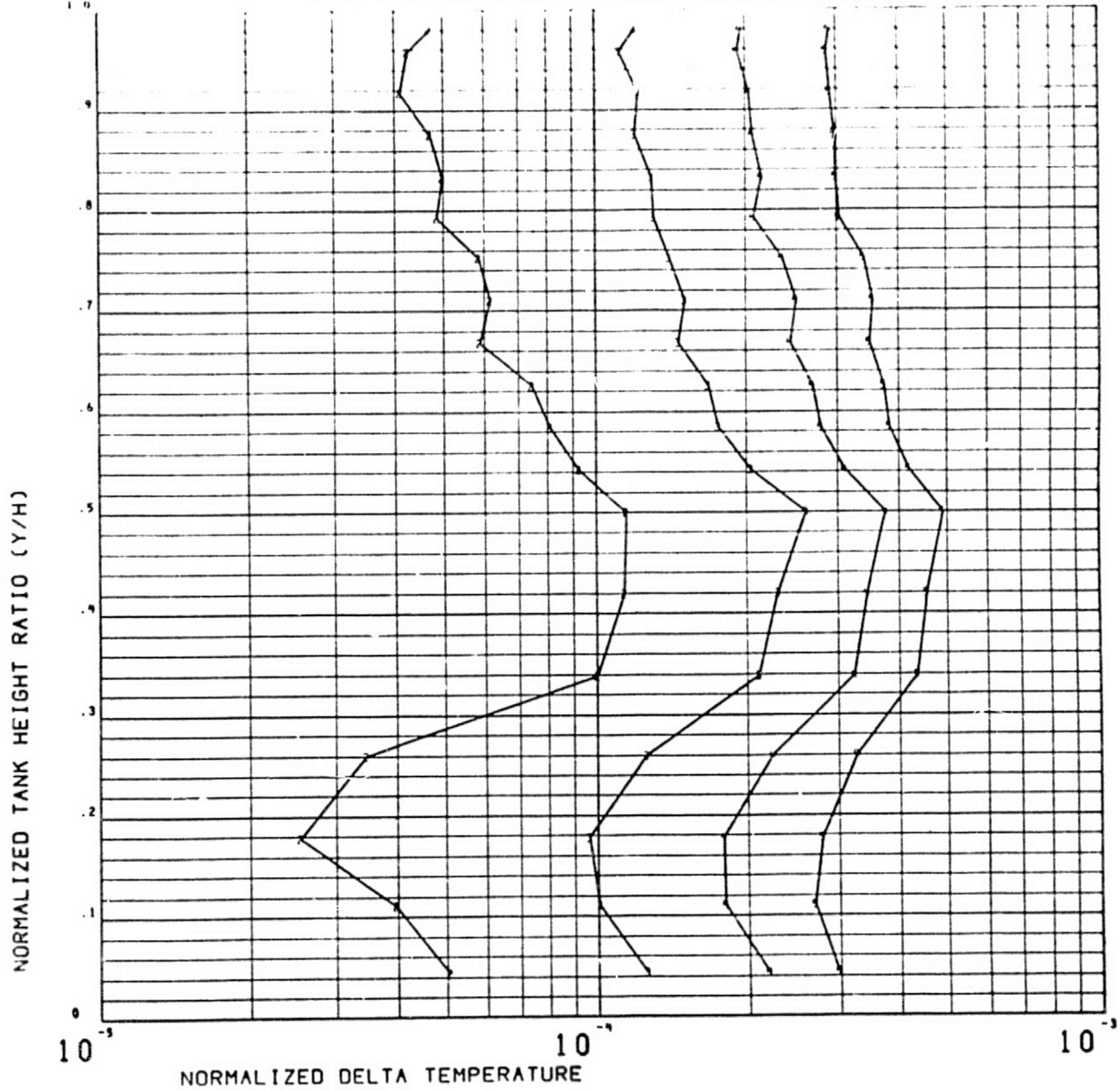


FIGURE 5.9-3b

18 IN. TNK TST 1GΣBS STRAT DTNORM PROFILE

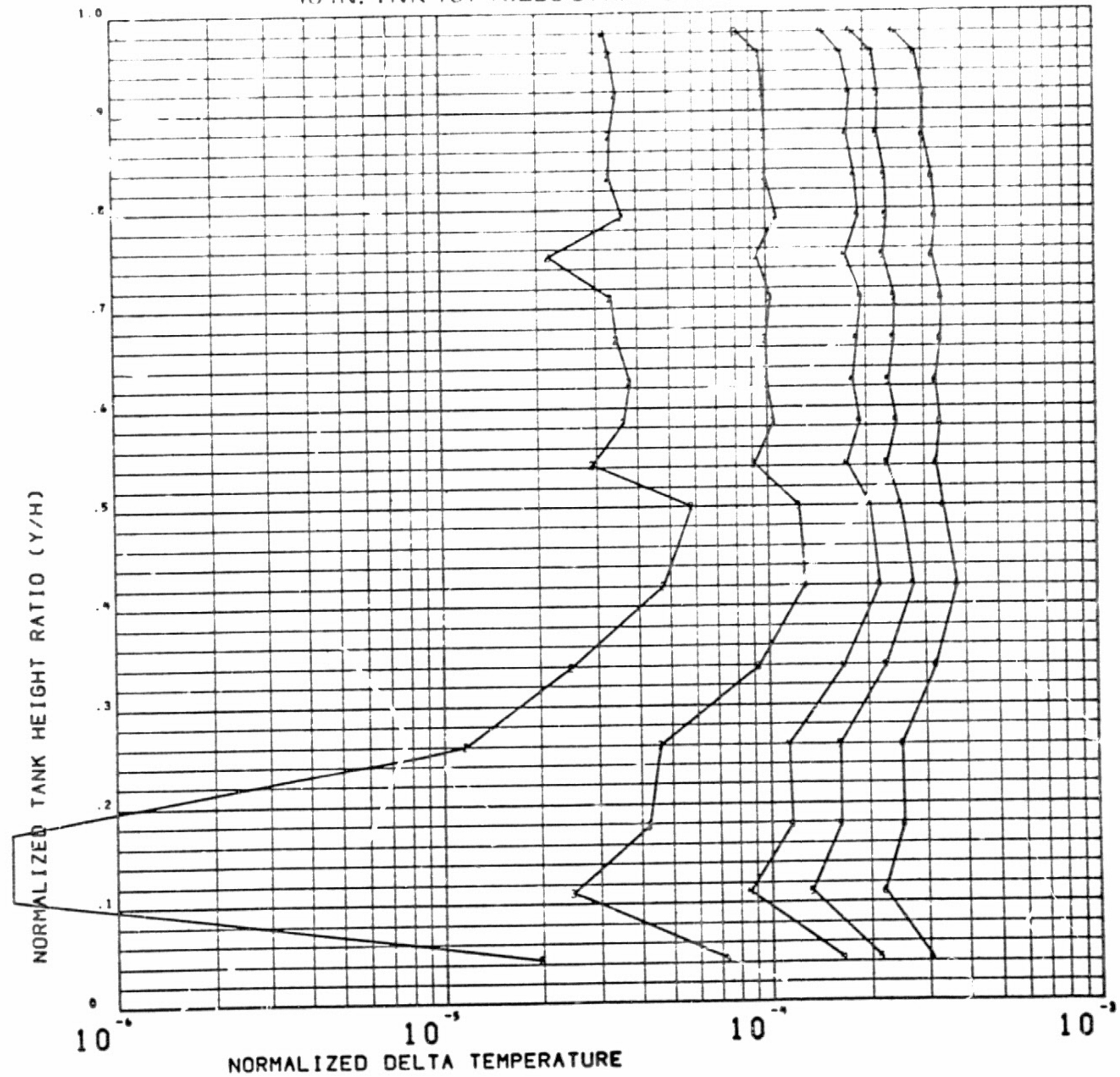


FIGURE 5.9-3c
18 IN. TNK TST 1GΣD STRAT DTNORM PROFILE

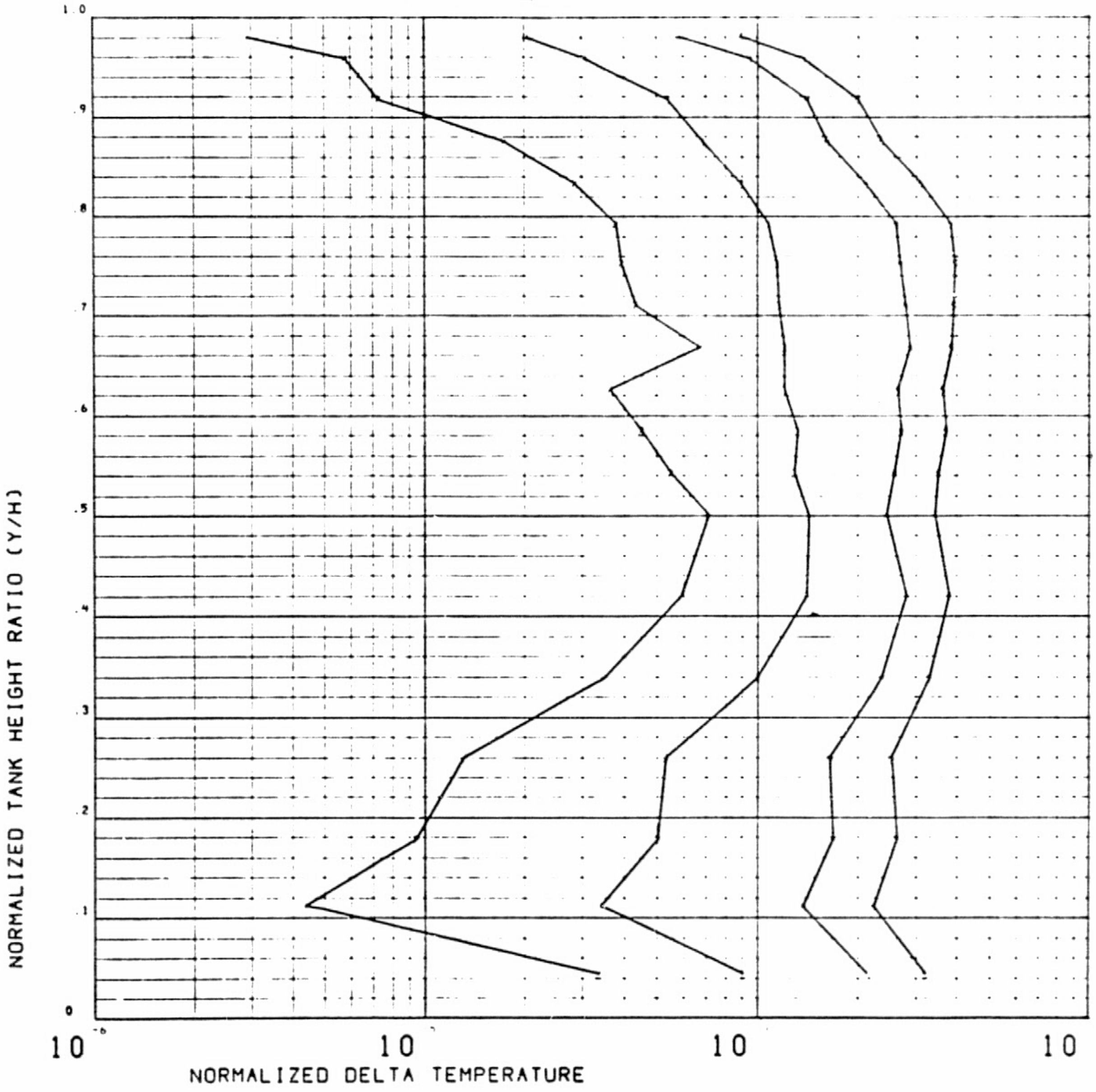


FIGURE 5.9-4a

6 IN. TNK TST 27GΣ1S BULK ULGE γ LIQ TEMP HISTORIES

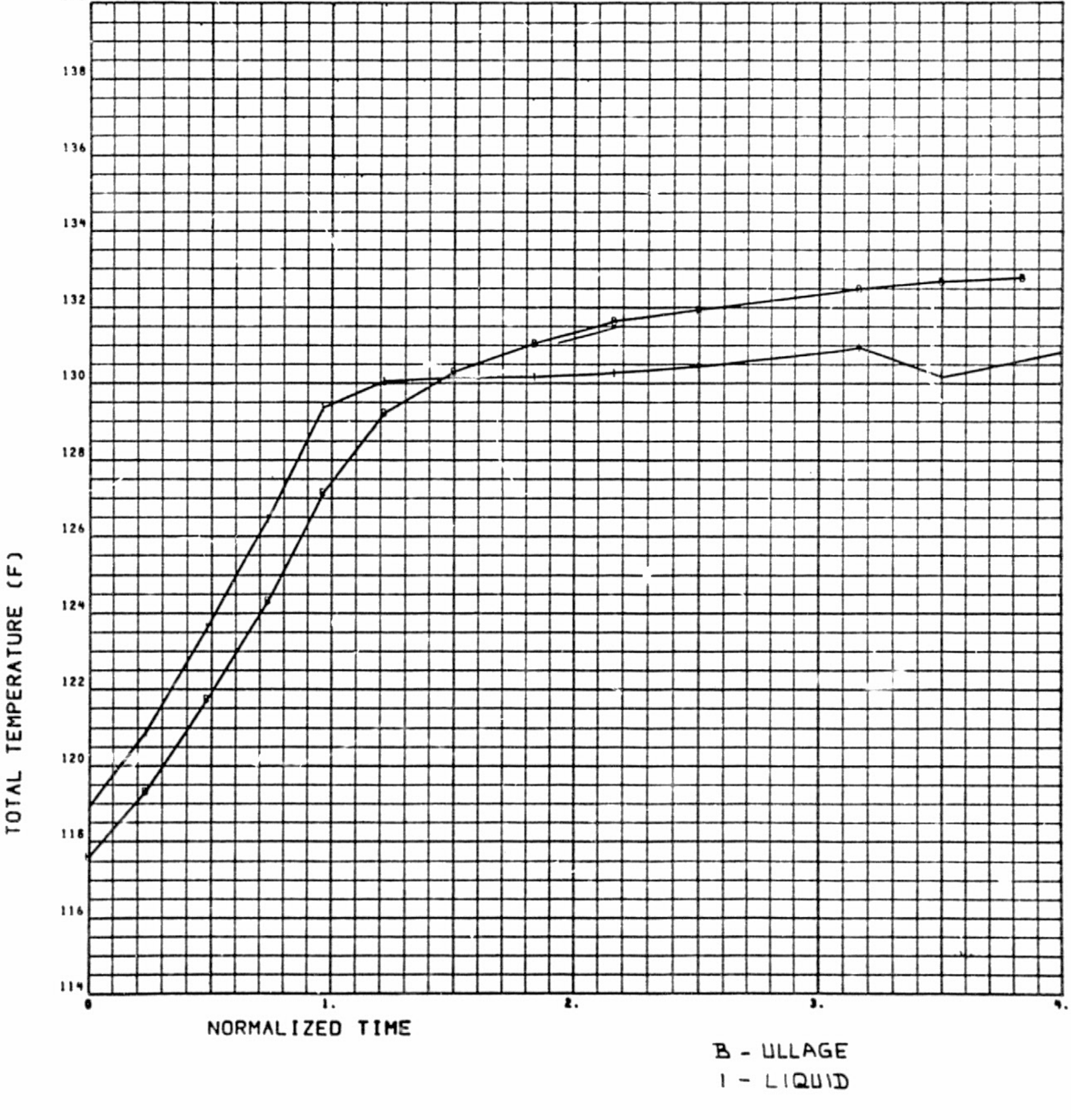


FIGURE 5.9-4b

18 IN. TNK TST 1GΣBS BULK ULGE Y LIQ TEMP HISTORIES

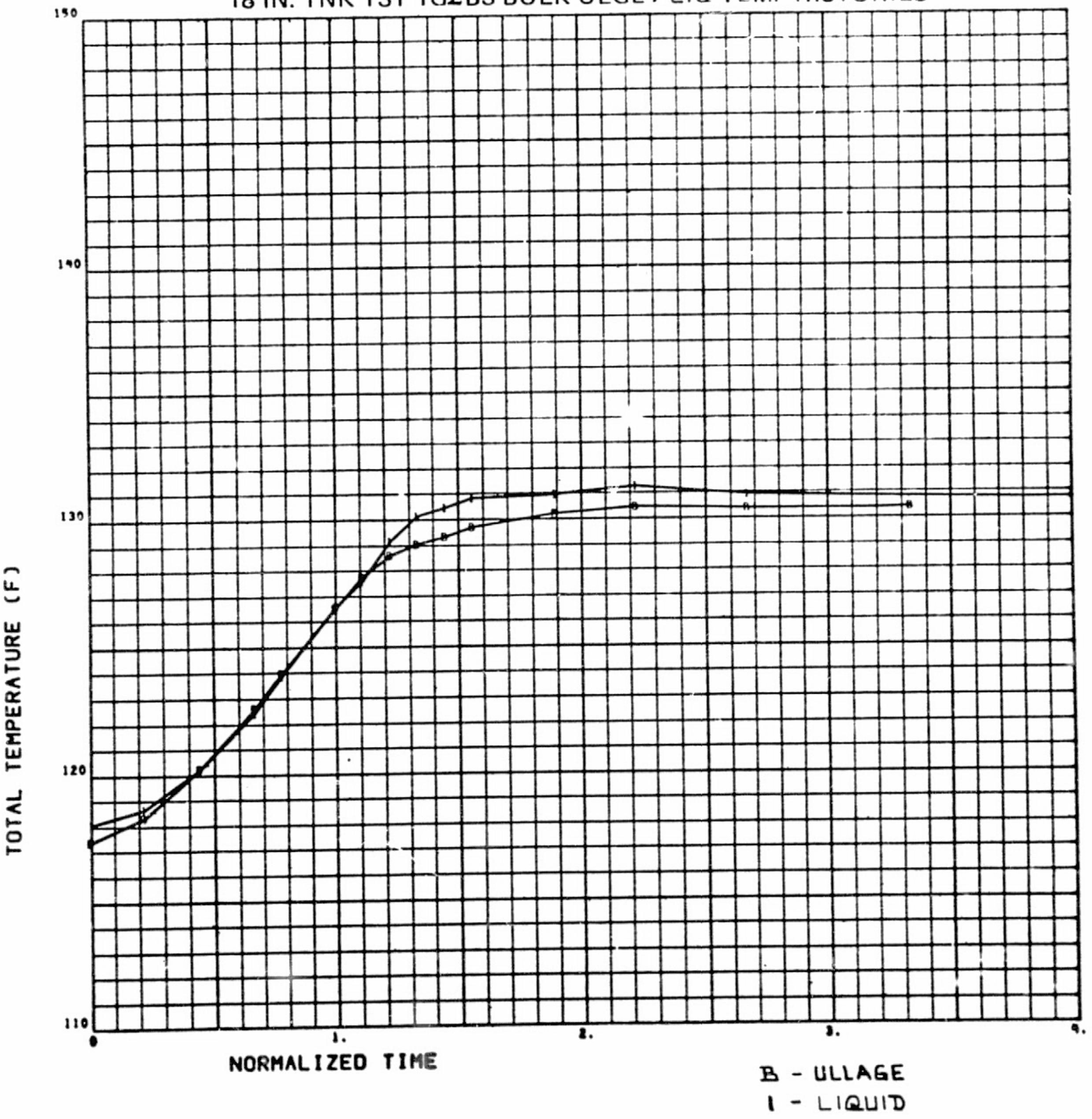


FIGURE 5.9 4c

18 IN. TNK TST 1GΣD BULK ULGE/LIQ TEMP HISTORIES

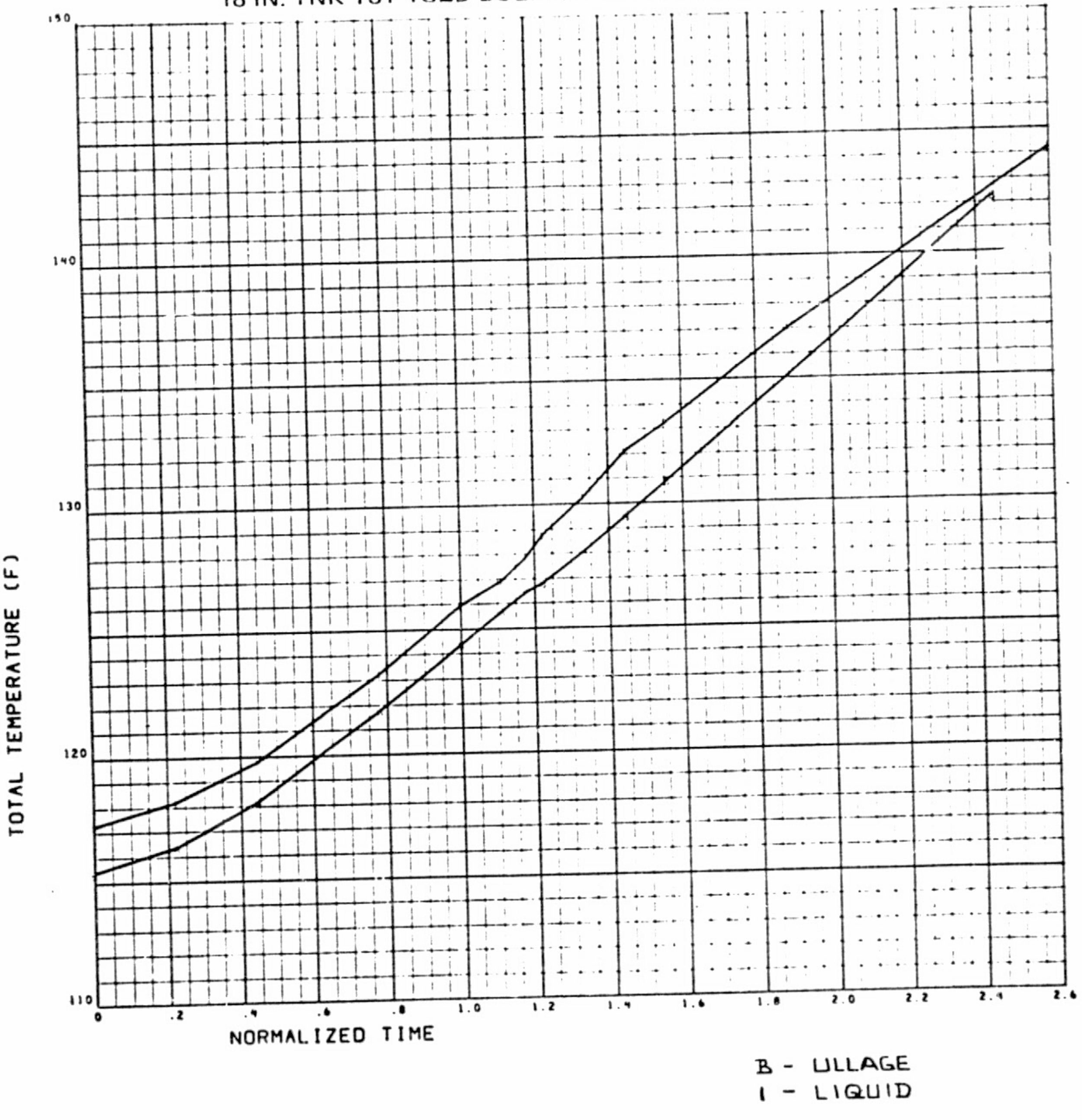


FIGURE 5.9-5a
6 IN. TNK TST 27GΣ1S TANK PRESSURE HISTORY

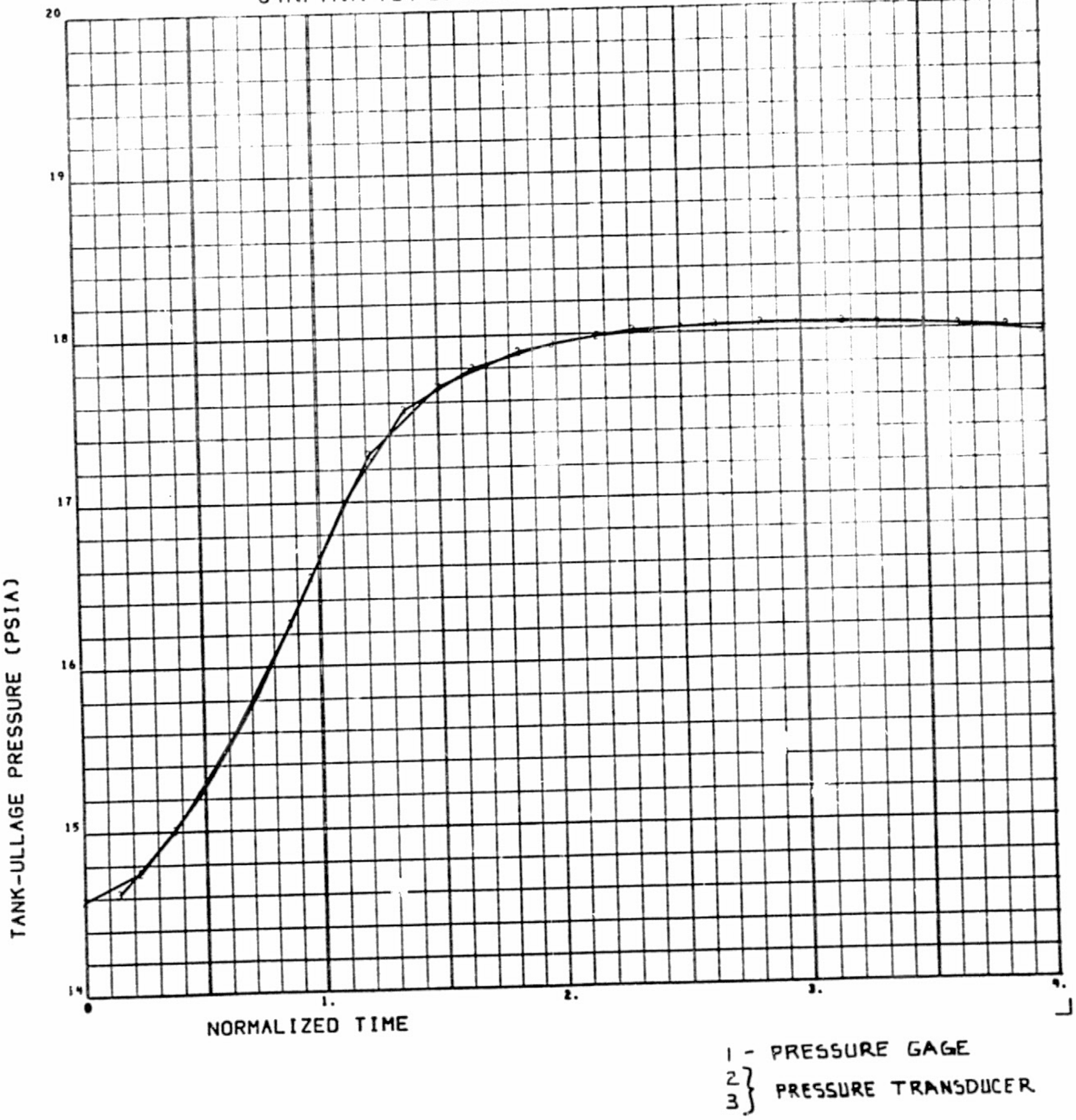


FIGURE 5.9-5b

18 IN. TNK TST 1GΣBS TANK PRESSURE HISTORY

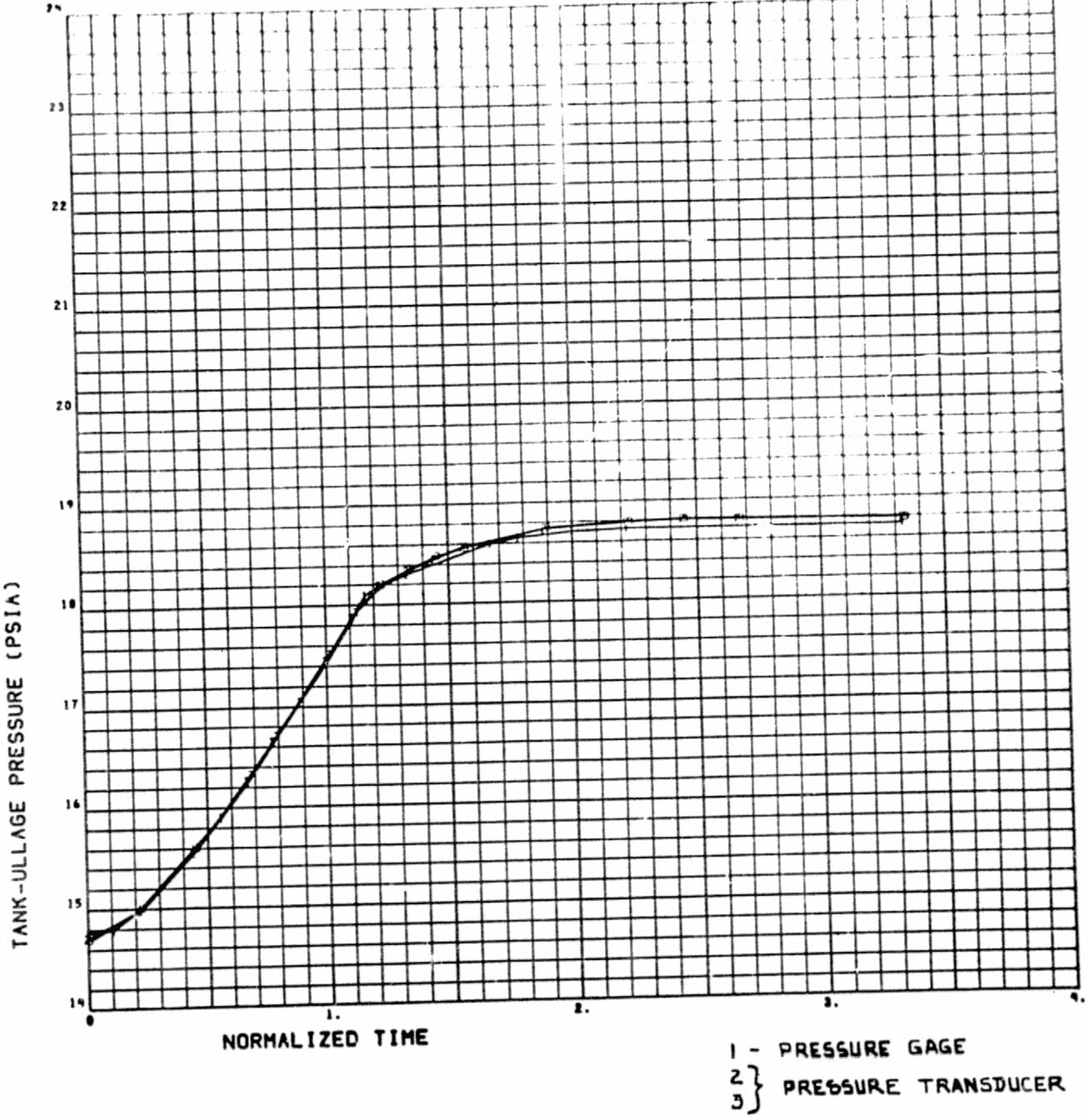
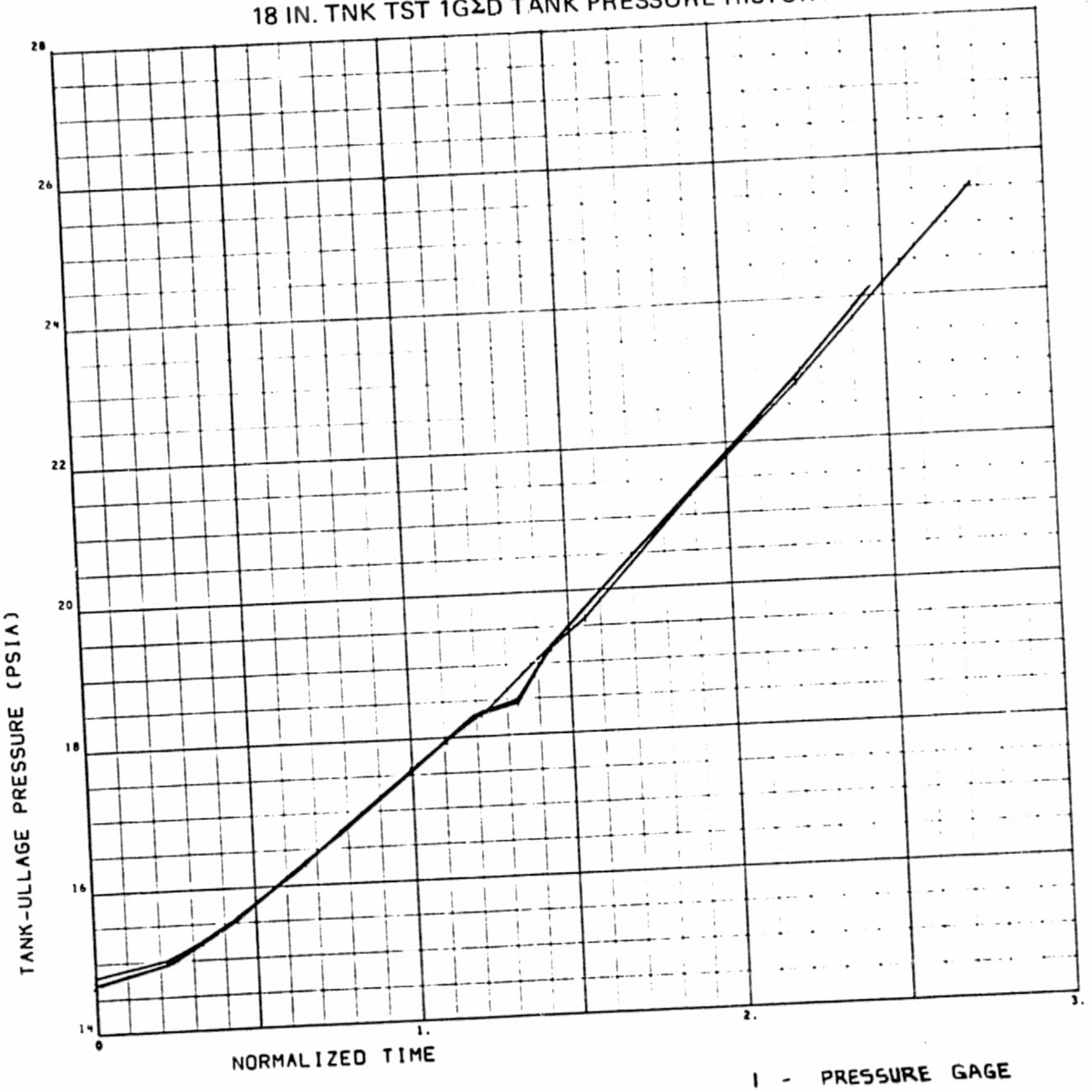


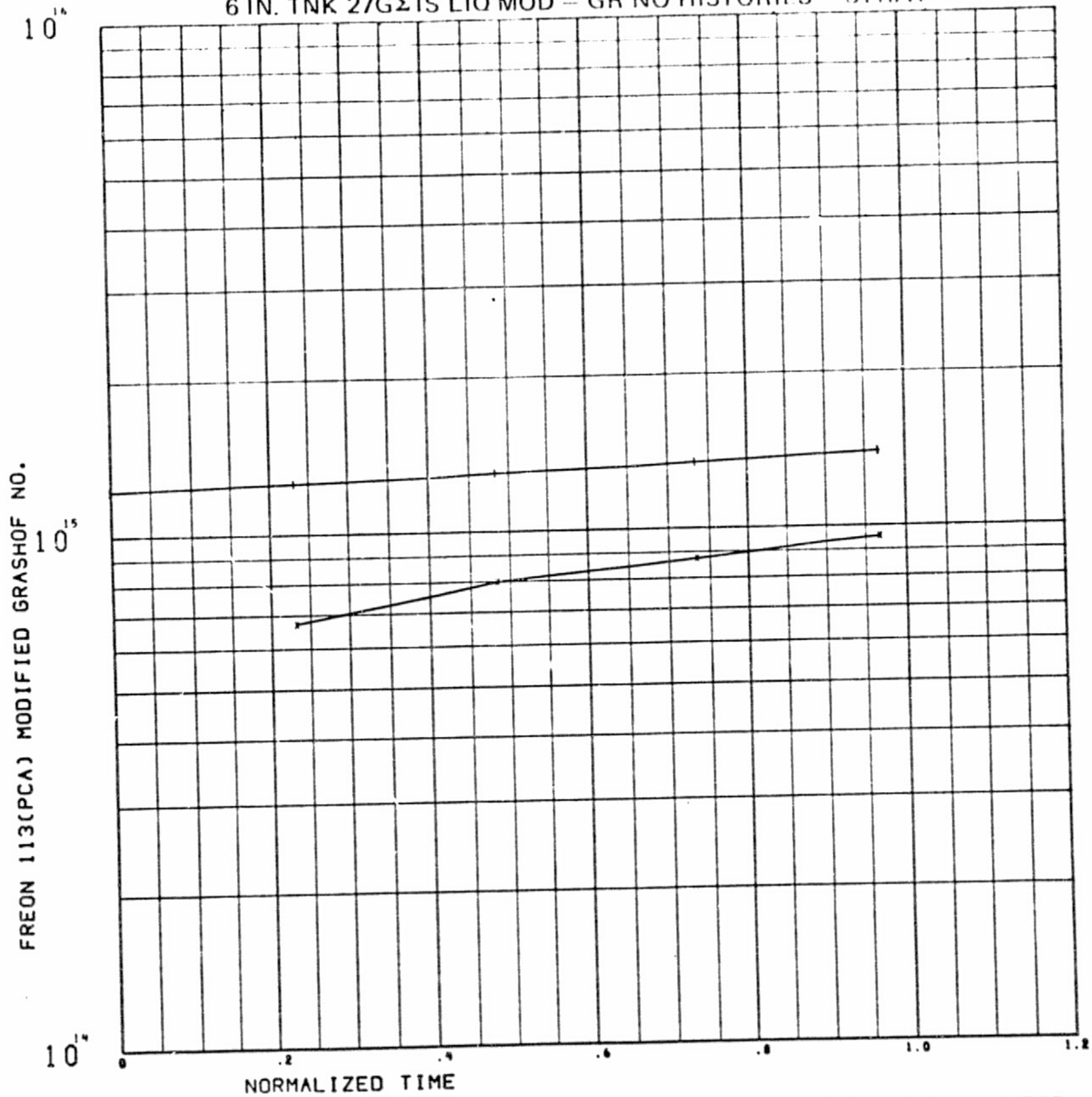
FIGURE 5.9-5c
18 IN. TNK TST 1GΣD TANK PRESSURE HISTORY



1 - PRESSURE GAGE
2 } PRESSURE TRANSDUCER
3 }

FIGURE 5.9 6a

6 IN. TNK 27GΣ1S LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$$

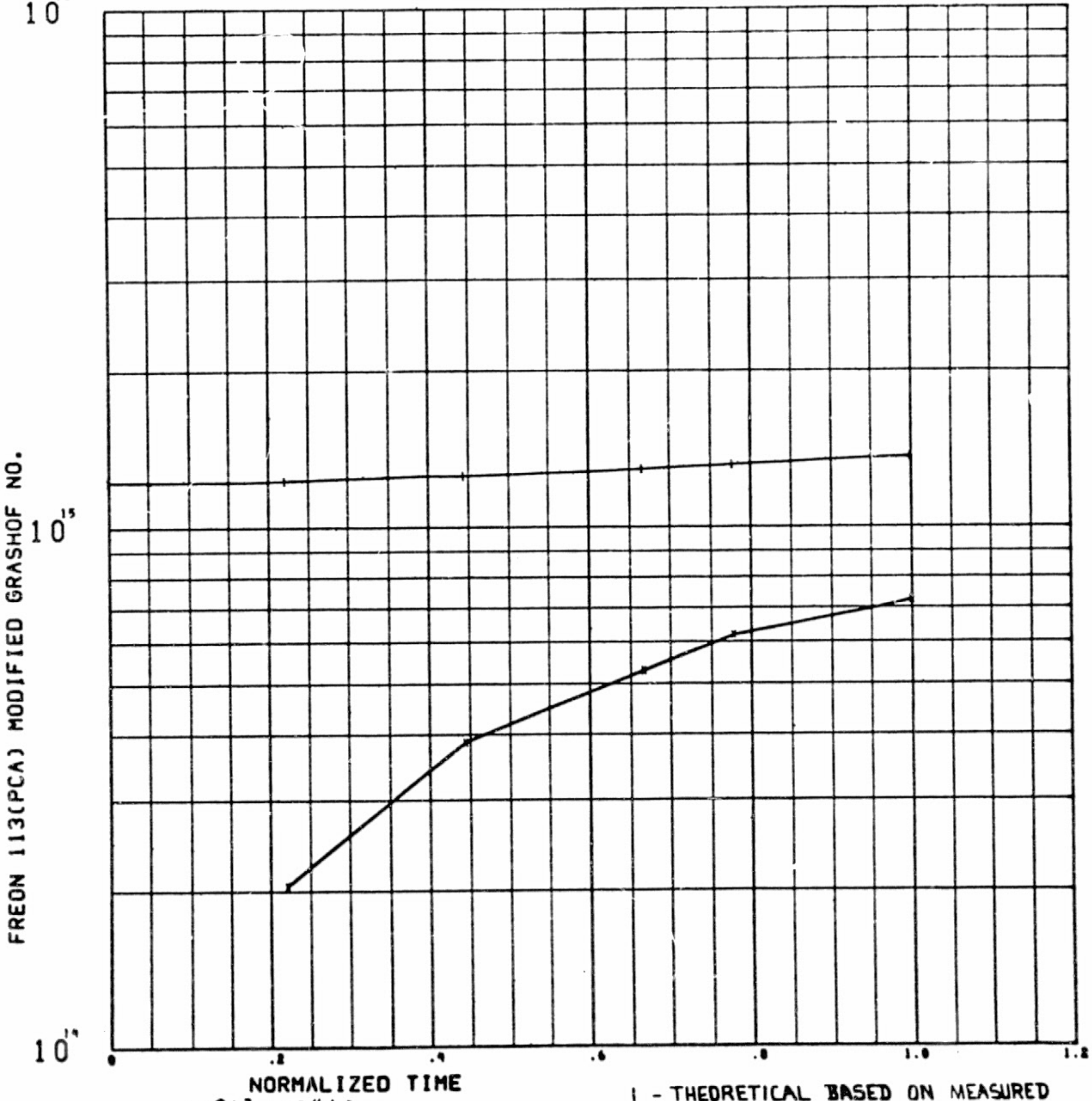
L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL BASED ON MEASURED q''_H WATTAGE INPUT

X - EXPERIMENTAL BASED ON MEASURED q''_ℓ FLUID

FIGURE 5.9-6b

18 IN. TNK 1GΣBS LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^{*} = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{K}\right)$$

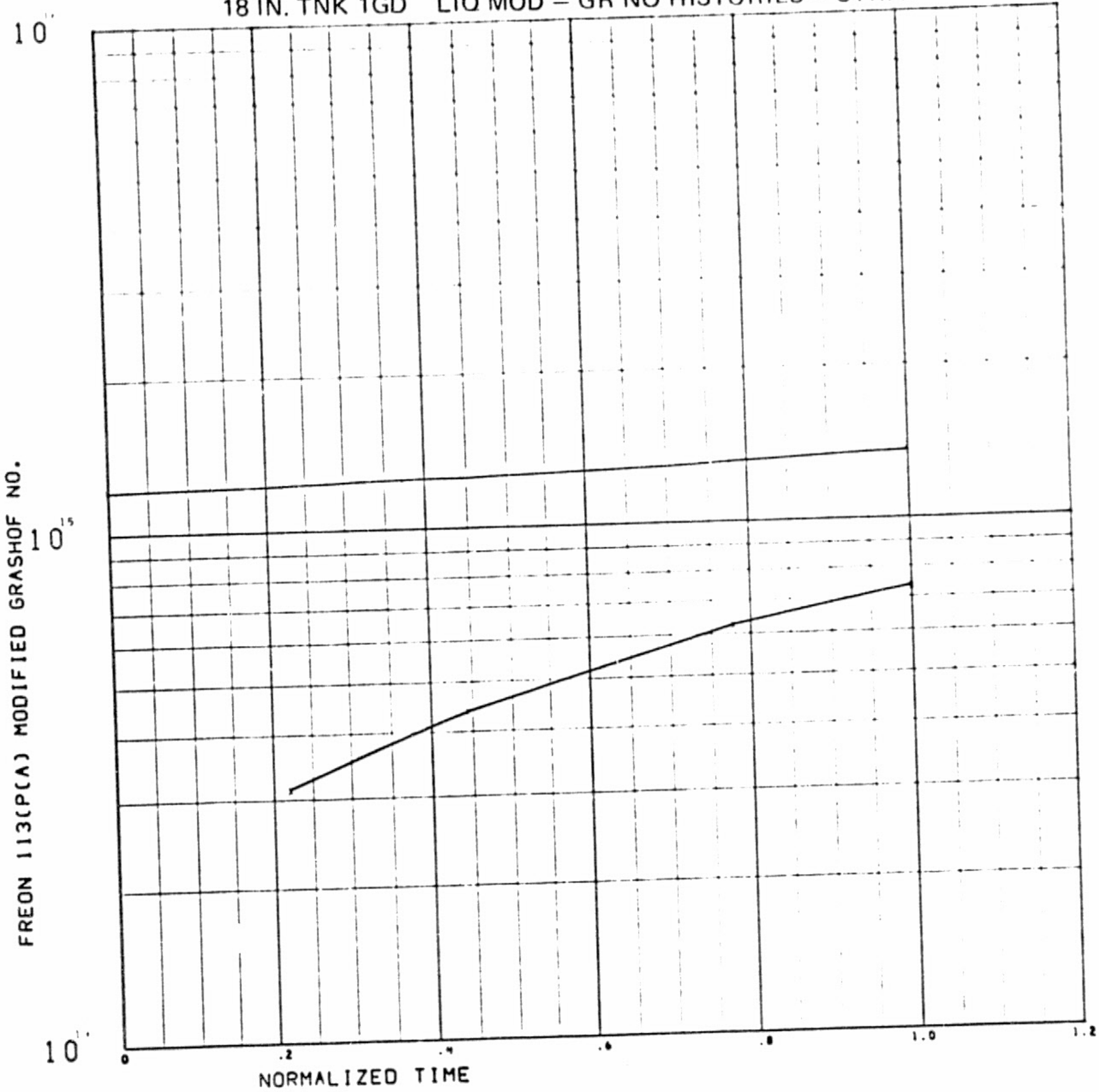
L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL BASED ON MEASURED q_H'' WATTAGE INPUT

X - EXPERIMENTAL BASED ON MEASURED q_ℓ'' FLUID

FIGURE 5.9-6c

18 IN. TNK 1GD LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q''L}{K}\right)$$

L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL BASED ON MEASURED q''_H WATTAGE INPUT

X - EXPERIMENTAL BASED ON MEASURED q''_l FLUID

FIGURE 5.9-7a

6 IN. TNK 27GΣ1S LIQ FOURIER NO HISTORY

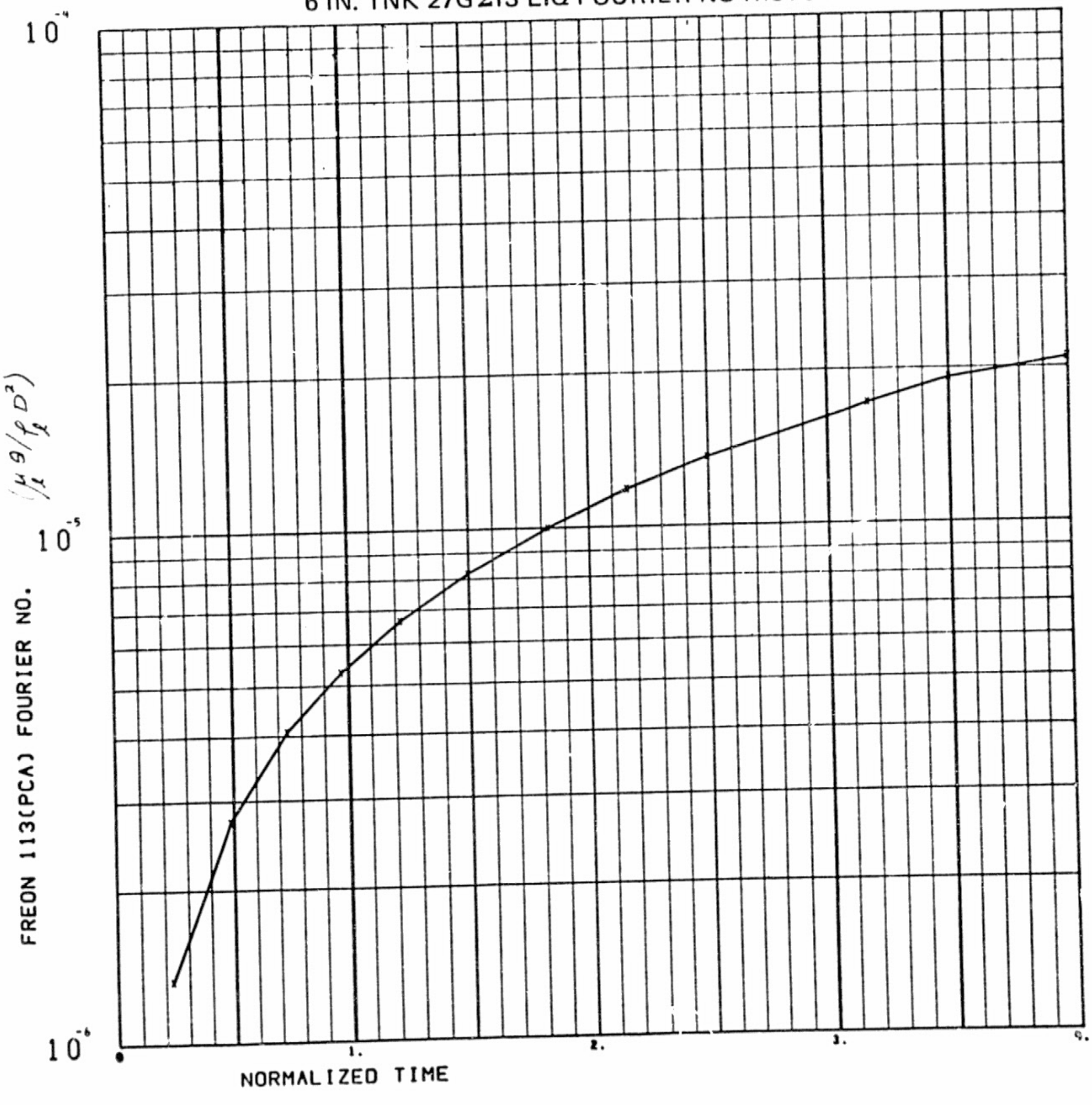


FIGURE 5.9-7b

18 IN. TNK 1GΣBS LIQ FOURIER NO HISTORY

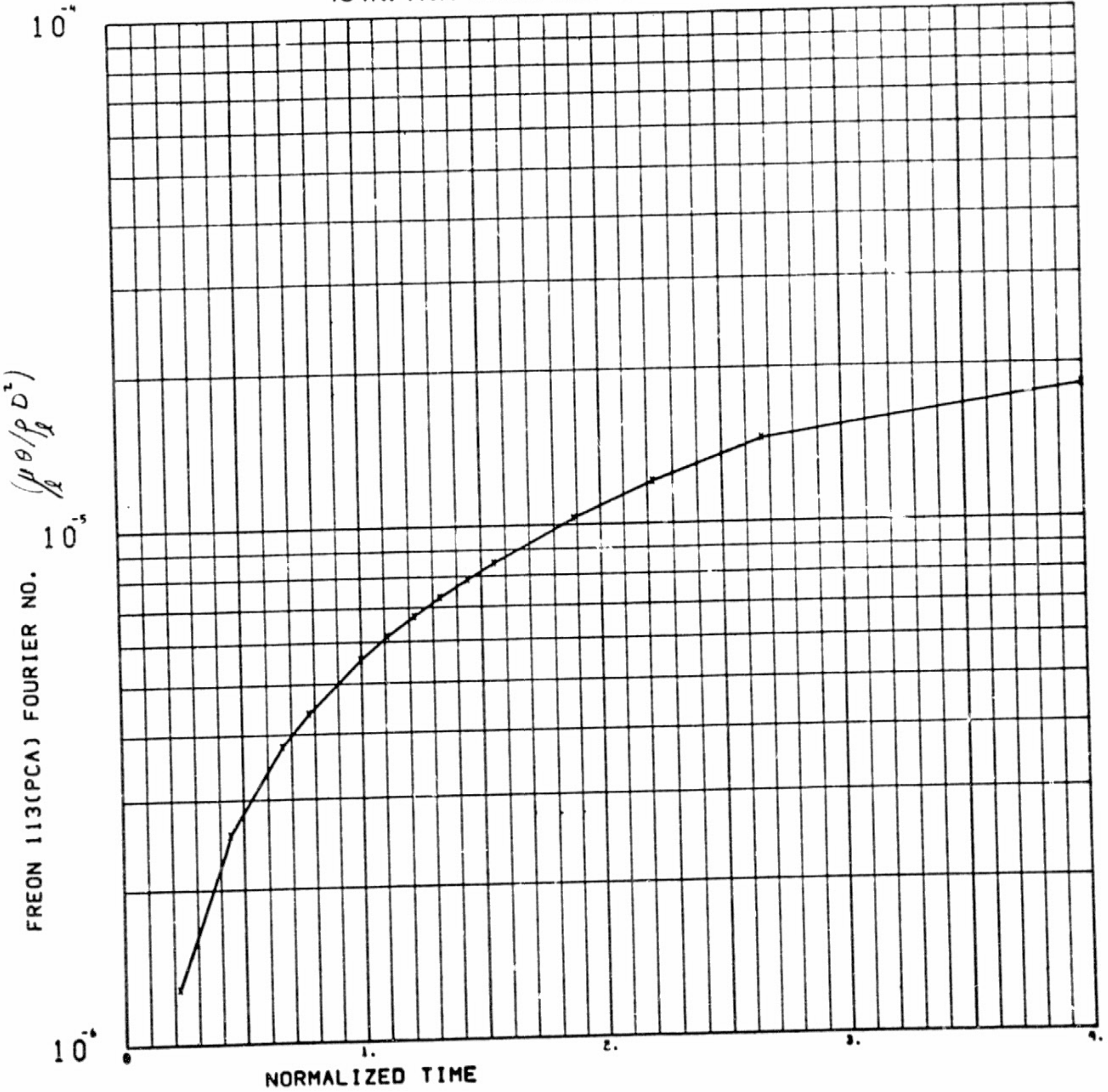
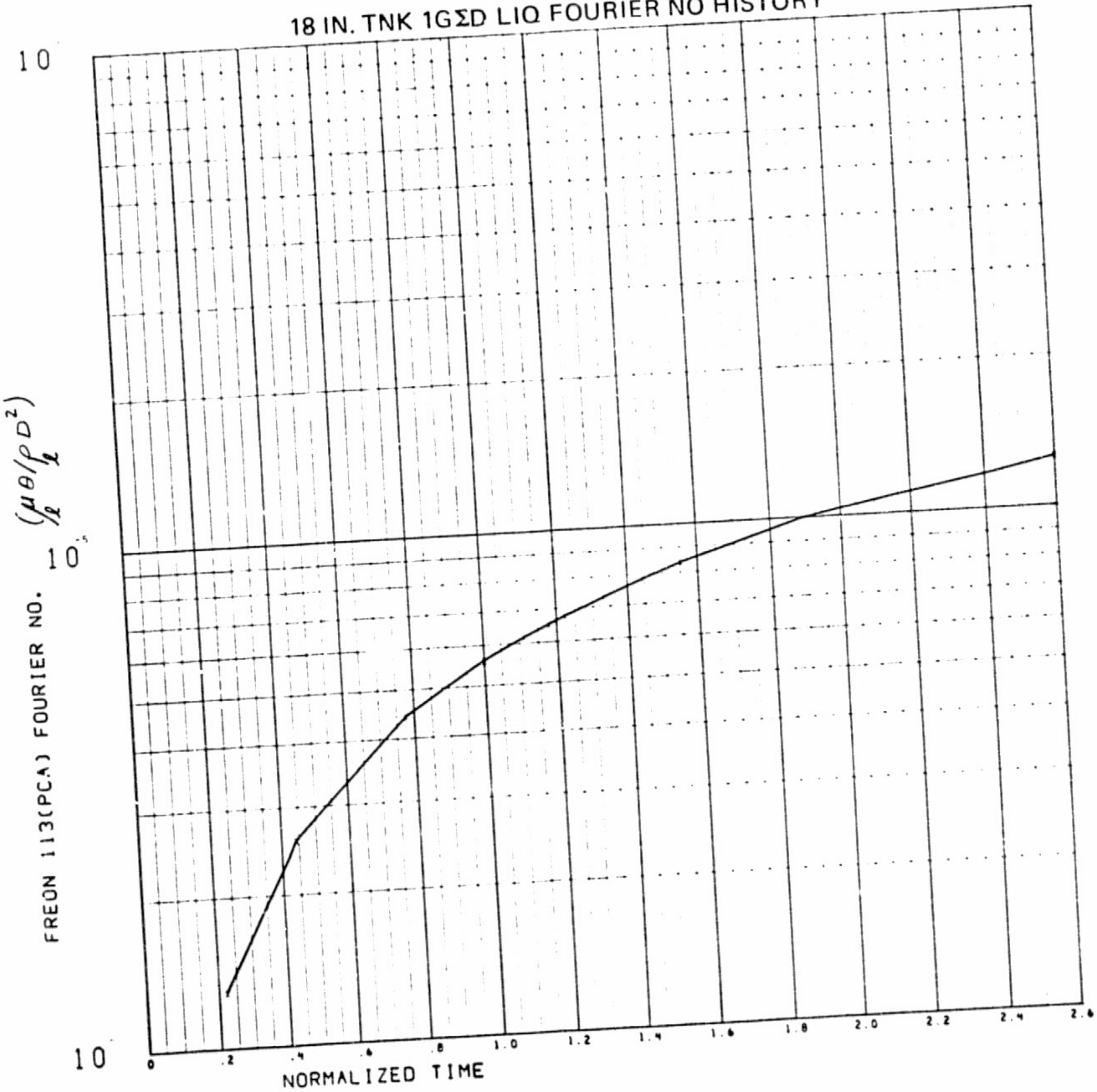


FIGURE 5.9-7c

18 IN. TNK 1GΣD LIQ FOURIER NO HISTORY



Section 5.10

SCALING SET

6-in.-Dia Tank Test	18-in.-Dia Tank Test
27G	1G
Test #3S	Test #IS

Table 5.10-1a. 6 IN. DIA. TANK TEST 27G#3S

```
         STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=   .3927       CYL AREA FT2=  1.5708       FLNGE AREA FT2=   .0365
DME WALL VOL FT3=   .00131       1/2 CYL WALL VOLFT3=   .00164      FLNGE VOL FT3=    .00076
DME MASS LBM=   .65596      MASS 1/2 CYL LBM=   .81996     FLANGE MASS=   .38058

 LIQ VOL FT3=   .22907      ULLAGE VOL FT3=    .03272

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12=2884.4216    H34=2884.4216    H56=2884.4216    H910=2884.4216    H78=    0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)=2884.4216
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=    0.0000
EST.HT INPUT LIQ(STRAT)BTU=    94.392      (STRAT+DESTRAT)BTU=     0.000
EST.LIQ TEMP INCRSE(STRAT)=    19.3591F       (STRAT+DESTRAT)=     0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=     0.000       (STRAT+DESTRAT)BTU=     0.000
```

Table 5.10-1b. 18 IN. DIA. TANK TEST 1G#1S

```
         STRUCTURAL GEOMETRIC TANK WTS-WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=  3.5343       CYL AREA FT2= 14.1372       FLNGE AREA FT2=   .3281
DME WALL VOL FT3=    .03299      1/2 CYL WALL VOLFT3=   .04418      FLNGE VOL FT3=    .02051
DME MASS LBM= 16.53031      MASS 1/2 CYL LBM= 22.13880     FLANGE MASS= 10.27571

 LIQ VOL FT3=  6.18501      ULLAGE VOL FT3=    .88357

 INPUT HEAT FLUXES (BTU/HR-FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 966.6835    H34= 966.6835    H56= 964.7540    H910= 962.3422    H78=    0.0000

EST.HT FLUX IN LIQ (BTU/HR-FT2)= 965.0435
EST.HT FLUX IN ULLGE (BTU/HR-FT2)=    0.0000
EST.HT INPUT LIQ(STRAT)BTU= 2558.059      (STRAT+DESTRAT)BTU=     0.000
EST.LIQ TEMP INCRSE(STRAT)=    19.4362F       (STRAT+DESTRAT)=     0.0000F

EST.HT INPUT ULLAGE(STRAT)BTU=     0.000       (STRAT+DESTRAT)BTU=     0.000
```

Table 5.10-2a. 6 IN. DIA TANK TEST 27G #3S (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	.233	.484	.733	1.000
TAU	0.000	.233	.484	.733	1.000
1	116.917	121.333	127.458	133.250	139.000
2	117.125	125.542	133.708	140.292	145.750
3	117.792	124.458	132.125	138.250	144.417
4	117.292	123.542	131.208	137.125	142.396
5	116.792	122.625	130.292	136.000	140.375
6	116.833	123.042	130.167	135.250	139.542
7	117.292	123.833	130.021	134.646	139.188
8	117.750	124.625	129.875	134.042	138.833
9	115.208	118.292	121.542	123.875	127.625
10	117.583	137.833	147.167	153.708	159.958
11	117.625	138.000	147.792	156.125	161.625
12	118.000	140.167	150.833	158.917	164.125
13	116.625	137.625	146.417	150.792	147.292
14	115.375	120.667	126.375	131.500	136.750
15	116.333	126.250	132.667	138.417	143.917
16	117.333	127.417	133.625	139.583	145.083
17	116.111	124.778	130.125	135.056	139.333
18	115.500	123.458	128.375	132.792	136.458
19	115.625	118.458	120.958	123.792	126.708
20	117.583	137.833	147.167	153.708	159.958
21	117.625	138.000	147.792	156.125	161.625
22	118.000	140.167	150.833	158.917	164.125
23	116.625	137.625	146.417	150.792	147.292
24	115.792	118.625	123.375	128.208	133.458
25	115.000	11[illegible].458	121.125	125.292	130.417
26	114.042	117.375	120.958	125.167	130.167
27	106.208	117.333	120.958	124.917	130.083
28	115.917	117.292	119.167	121.542	124.667
29	114.958	116.042	118.292	121.583	125.833
30	115.333	118.417	123.042	127.833	133.083
31	118.847	134.389	138.250	139.583	140.667
32	118.875	134.417	138.583	139.417	140.833
33	111.958	114.917	118.333	120.042	122.958
34	106.417	107.708	109.271	109.979	117.563

Table 5.10-2a. 6 IN. DIA TANK TEST 27G #3S (Page 2 of 2)

35	100.875	100.500	100.208	99.917	112.167
36	118.833	134.375	138.083	139.667	140.583
37	115.750	118.250	121.458	125.250	130.250
38	115.750	119.000	123.292	128.125	133.292
39	116.208	119.792	124.542	129.208	134.125
40	116.750	120.583	125.208	129.917	134.833
41	117.750	121.542	126.625	131.917	136.250
42	117.292	121.333	126.375	131.333	135.750
43	118.458	122.458	127.542	132.375	136.875
44	117.500	121.479	126.333	131.458	136.333
45	118.792	123.042	128.250	132.417	136.750
46	117.708	121.625	126.292	131.583	136.917
47	119.208	123.833	129.250	134.458	138.167
48	118.125	122.000	126.958	130.958	135.417
49	118.667	123.333	127.968	132.875	138.250
50	119.500	123.417	128.167	132.833	137.833
51	120.125	123.861	128.611	133.097	137.708
52	119.333	123.222	128.201	132.757	137.563
53	118.542	122.583	127.792	132.417	137.417
54	119.333	123.222	128.201	132.757	137.563
55	119.333	123.222	128.201	132.757	137.563
56	119.333	123.222	128.201	132.757	137.563
57	119.333	123.222	128.201	132.757	137.563
58	120.750	124.306	129.056	133.361	137.583
59	121.375	124.750	129.500	133.625	137.458
60	120.333	123.250	127.458	131.625	135.458
61	118.250	120.250	123.375	127.625	131.458
62	118.750	120.458	123.958	127.167	131.458
63	120.750	122.125	125.792	130.000	133.250
64	122.583	124.208	127.792	130.917	134.875
65	118.250	119.000	122.042	125.167	128.000
66	118.625	119.333	121.875	125.417	126.542
67	120.292	121.083	123.125	124.250	125.875
68	118.361	119.347	121.250	124.014	125.639
69	118.167	118.625	120.417	123.125	124.667
70	118.292	120.083	121.458	123.500	125.708
71	119.792	120.667	122.583	125.292	127.042
72	118.667	121.833	123.042	125.375	124.833
73	118.667	121.833	123.042	125.375	124.833
74	112.125	113.917	116.000	118.583	121.125
75	99.750	100.958	102.458	103.833	105.417
76	107.750	108.125	108.792	109.667	110.667
77	90.417	90.750	91.250	91.625	92.042

Table 5.10-2b. 18 IN. DIA TANK TEST 1G #IS (Page 1 of 2)

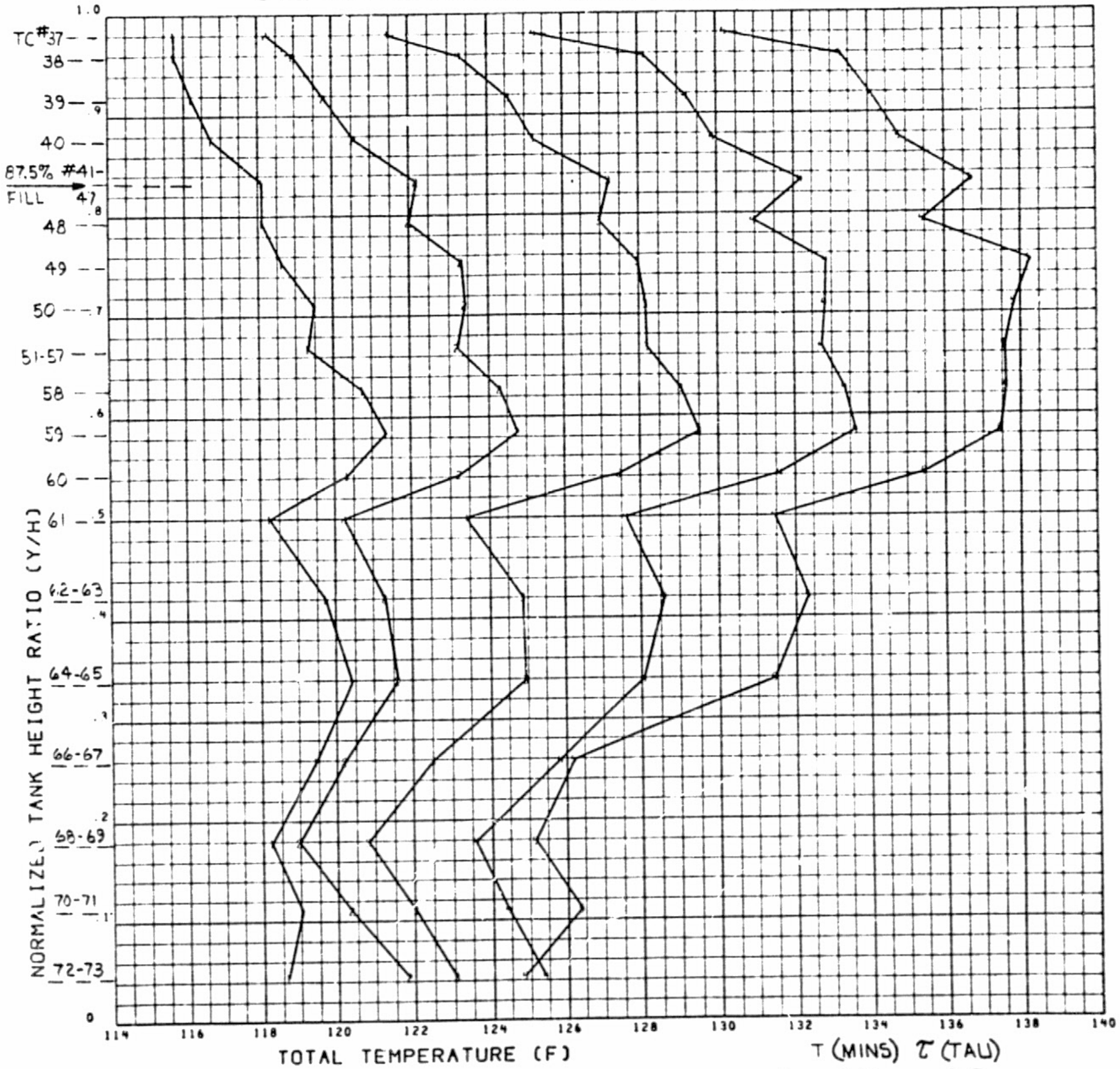
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	2,000	4,000	5,000	7,000	9,000
TAU	0.000	,222	,444	.556	,778	1,000
1	119,167	124,792	128,208	129,958	133,042	136,250
2	121,146	128,833	132,813	134,708	137,979	141,438
3	123,125	132,875	137,417	139,458	142,917	146,625
4	123,917	134,458	139,208	141,167	144,625	148,250
5	119,583	131,792	137,083	138,708	142,000	145,458
6	117,667	133,750	138,292	139,708	143,083	146,625
7	121,833	133,917	139,250	140,375	143,708	146,333
8	117,833	130,958	135,083	136,708	139,583	142,667
9	117,875	122,667	125,542	127,042	129,958	132,708
10	124,500	149,625	155,708	157,708	161,667	163,167
11	126,417	146,792	153,583	155,750	159,625	162,667
12	117,917	148,708	153,625	155,833	158,875	162,000
13	117,875	147,583	152,083	153,042	156,375	159,208
14	119,167	124,792	128,208	129,958	133,042	136,250
15	120,833	126,583	132,833	134,375	137,583	139,792
16	121,542	127,958	131,833	133,875	137,375	141,000
17	117,625	127,083	131,417	132,917	136,375	139,750
18	117,833	130,958	135,083	136,708	139,583	142,667
19	117,708	123,208	126,208	127,958	131,083	134,208
20	124,500	149,625	155,708	157,708	161,667	163,167
21	126,458	157,667	162,625	164,708	168,125	171,542
22	118,208	148,458	153,833	155,500	158,833	161,833
23	117,875	147,583	152,083	153,042	156,375	159,208
24	118,000	120,375	124,375	126,417	130,417	134,542
25	117,792	120,000	123,500	125,375	129,167	133,458
26	117,708	120,000	123,500	125,292	129,083	133,417
27	117,708	119,917	123,333	124,958	128,792	133,083
28	117,792	119,125	121,250	122,375	124,958	127,792
29	117,625	119,292	122,125	123,750	127,167	131,250
30	117,833	120,542	124,542	126,583	130,750	134,792
31	119,375	135,542	140,292	142,458	145,458	148,750
32	119,500	141,458	145,667	148,417	151,875	154,833
33	118,292	124,583	127,708	129,042	131,667	134,083
34	116,875	119,979	121,708	122,542	124,042	125,375

Table 5.10-2b. 18 IN. DIA TANK TEST 1G #IS (Page 2 of 2)

35	115,458	115,375	115,708	116,042	116,417	116,667
36	119,583	140,917	145,625	147,208	150,125	152,917
37	117,917	120,167	123,458	125,125	128,917	132,917
38	117,875	120,458	124,375	126,333	130,750	134,917
39	118,125	120,917	125,000	127,042	131,250	135,208
40	118,292	121,417	125,292	127,375	131,208	135,583
41	118,042	120,375	123,208	124,958	128,958	133,042
42	118,292	121,000	124,292	126,375	130,625	134,625
43	118,417	121,125	124,875	126,625	130,750	133,542
44	118,458	120,333	124,000	125,500	129,542	133,333
45	118,125	120,917	124,333	126,208	130,125	133,000
46	118,667	121,625	125,875	127,833	131,667	135,167
47	118,583	122,000	126,000	128,167	132,000	134,958
48	118,792	121,667	125,375	127,167	130,833	135,333
49	118,250	120,958	124,042	125,917	129,500	134,542
50	118,000	120,000	122,875	124,583	129,292	133,375
51	118,125	119,833	122,375	124,000	127,250	131,500
52	117,875	120,000	122,750	124,792	128,333	133,333
53	118,333	121,333	124,792	126,958	130,625	134,583
54	117,972	120,000	122,903	124,986	128,736	133,056
55	117,958	120,083	122,917	124,458	128,625	131,917
56	118,167	120,000	123,208	125,375	129,542	132,500
57	117,958	120,625	123,958	125,958	129,458	133,833
58	118,167	119,292	122,000	123,875	127,125	131,583
59	117,833	119,292	122,167	124,292	127,583	131,833
60	117,708	118,750	121,417	123,208	126,333	130,167
61	118,125	118,833	120,750	122,292	124,917	127,667
62	118,083	119,083	121,583	123,167	126,125	129,042
63	117,792	118,708	121,125	122,917	125,833	128,542
64	118,042	118,792	121,014	122,514	125,403	128,458
65	117,792	118,375	120,458	122,042	125,000	128,167
66	117,958	118,208	119,875	121,208	123,958	127,292
67	117,625	117,708	119,000	120,292	122,792	125,625
68	117,667	117,625	119,250	120,500	123,583	126,333
69	117,792	117,917	119,542	121,042	123,700	126,833
70	117,875	118,167	119,042	120,292	122,667	125,625
71	117,625	117,583	118,875	120,208	122,708	125,458
72	117,667	118,083	120,250	121,917	124,917	127,833
73	117,833	118,542	120,750	122,708	125,375	128,333
74	89,625	89,500	89,417	89,792	90,000	90,125
75	98,083	98,042	98,417	99,083	99,708	100,375
76	85,375	85,167	85,167	85,500	85,500	85,542
77	96,583	96,417	96,417	96,708	100,833	96,792

FIGURE 5.10-1a
6 IN. TNK TST 27G23S – STRAT TEMPERATURE PROFILE

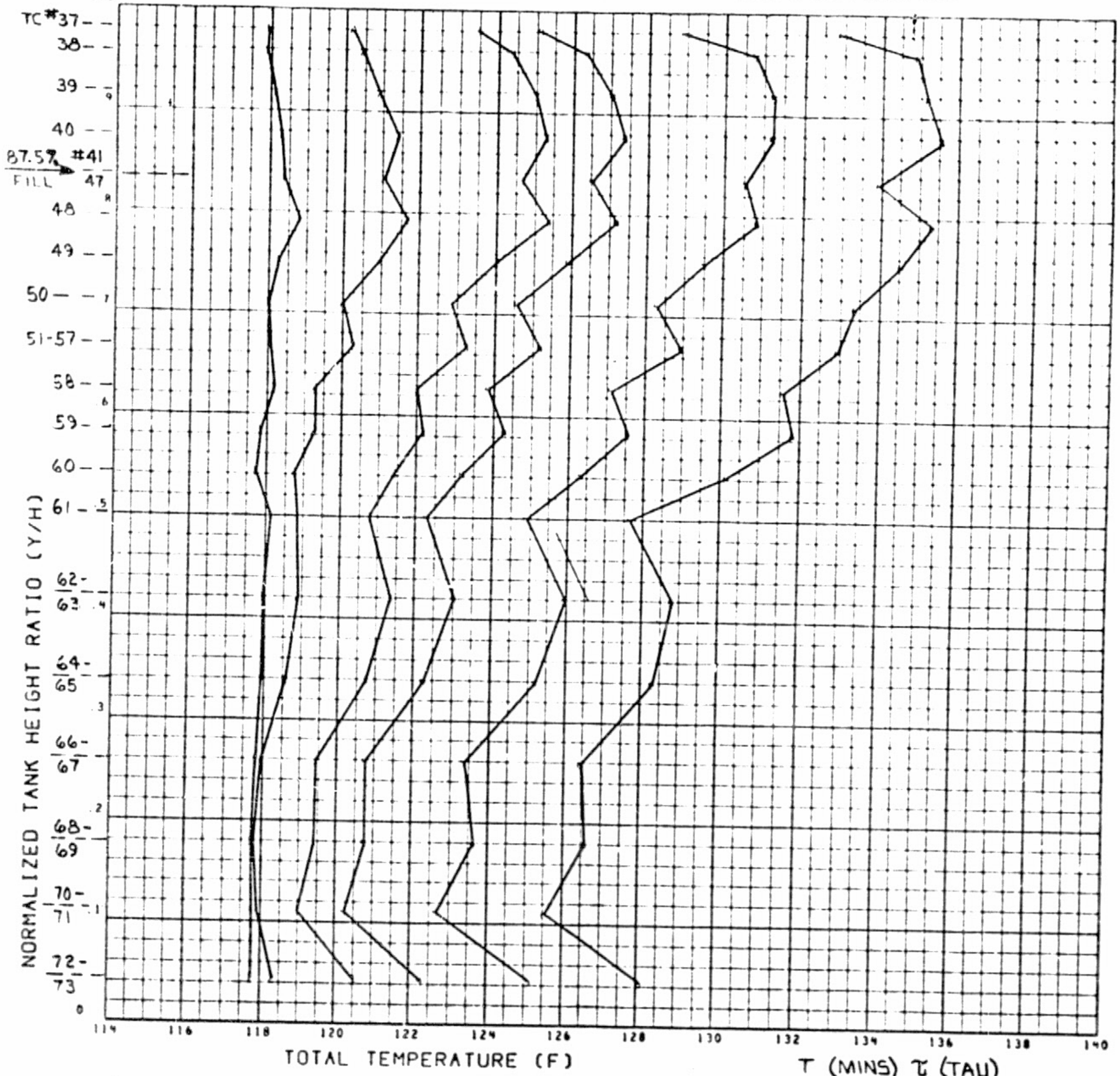


$q_H'' = 2880$ BTU/HR FT^2 LIQ. HT'G ONLY

	T (MINS)	τ (TAU)
1	0.0	0.0
2	.233	.233
3	.484	.484
4	.733	.733
5	1.000	1.000

FIGURE 5.10-1b

18 IN. TNK TST1GΣIS – STRAT TEMPERATURE PROFILE



$q''_{\delta_H} = 960$ BTU/HR FT LIQUID HT'G ONLY

	T (MINS)	τ (TAU)
1	0.0	0.0
2	2.0	.222
3	4.0	.444
4	5.0	.556
5	7.0	.778
6	9.0	1.000

FIGURE 5.10-2a

6 IN. TNK TST 27GΣ3S STRAT DEL TEMP PROFILE

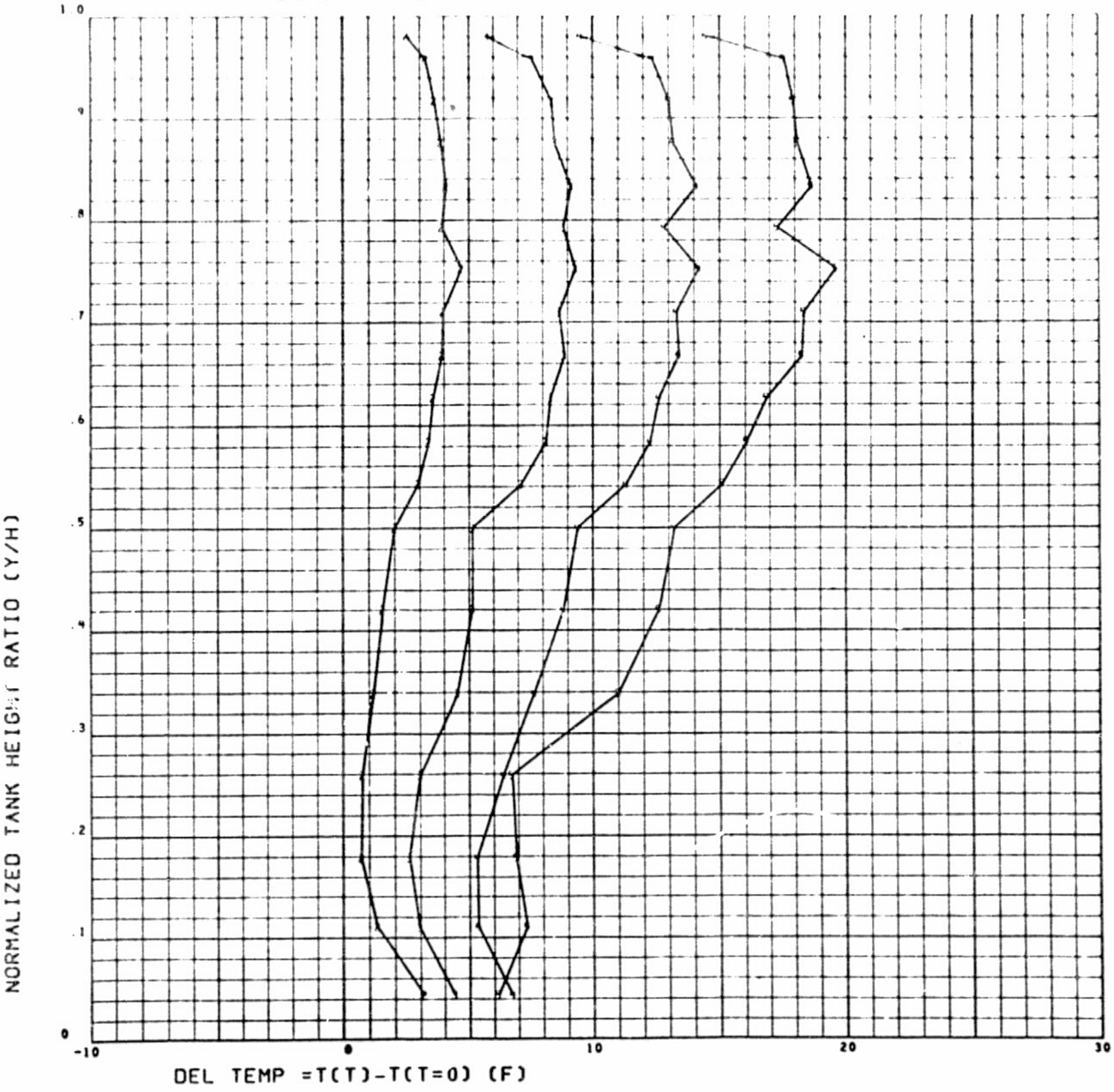


FIGURE 5.10-2b

18 IN. TNK TST 1GΣIS STRAT DEL – TEMP PROFILE

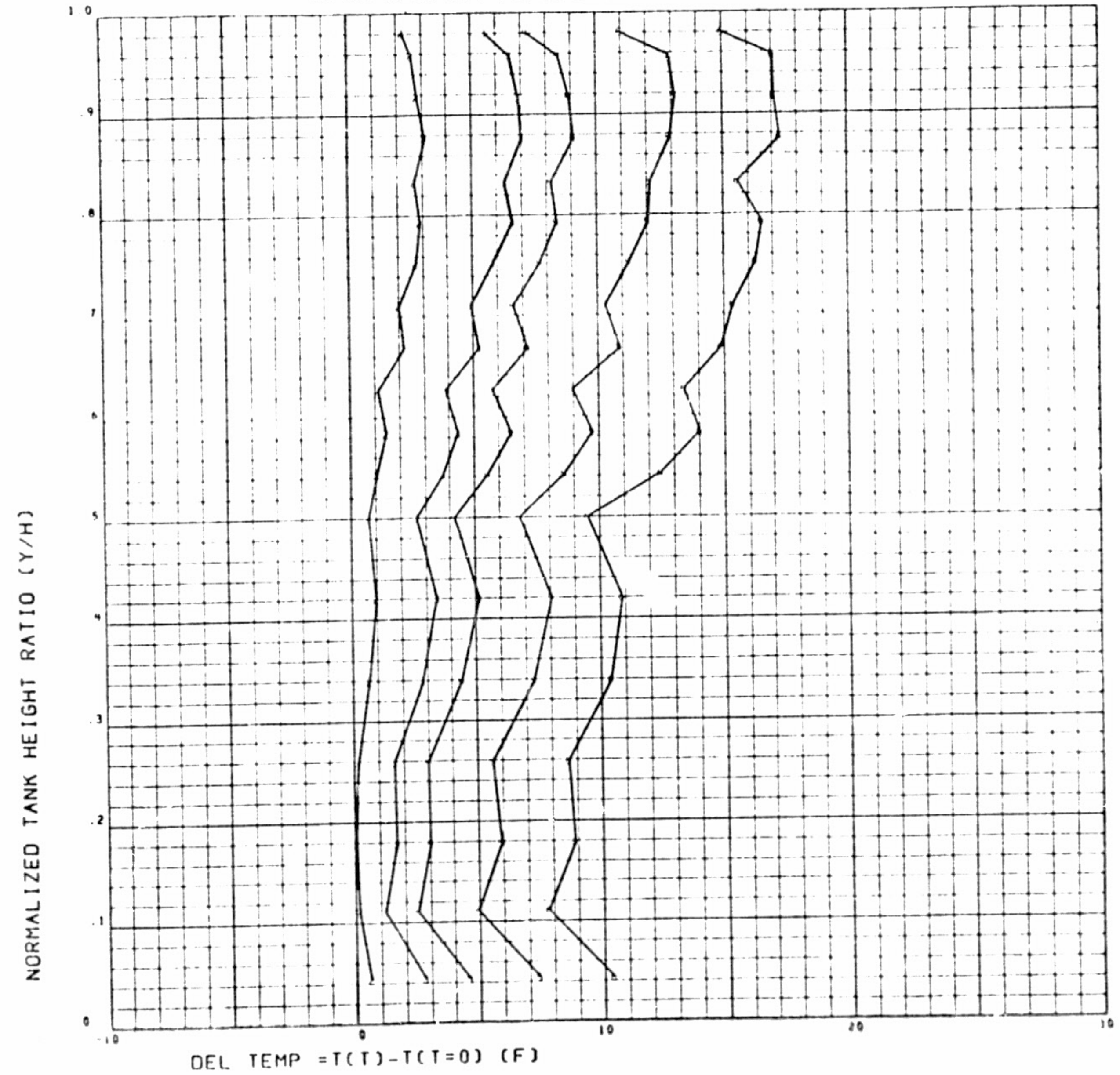


FIGURE 5.10-3a

6 IN. TNK TST 27GΣ3S STRAT DTNORM PROFILE

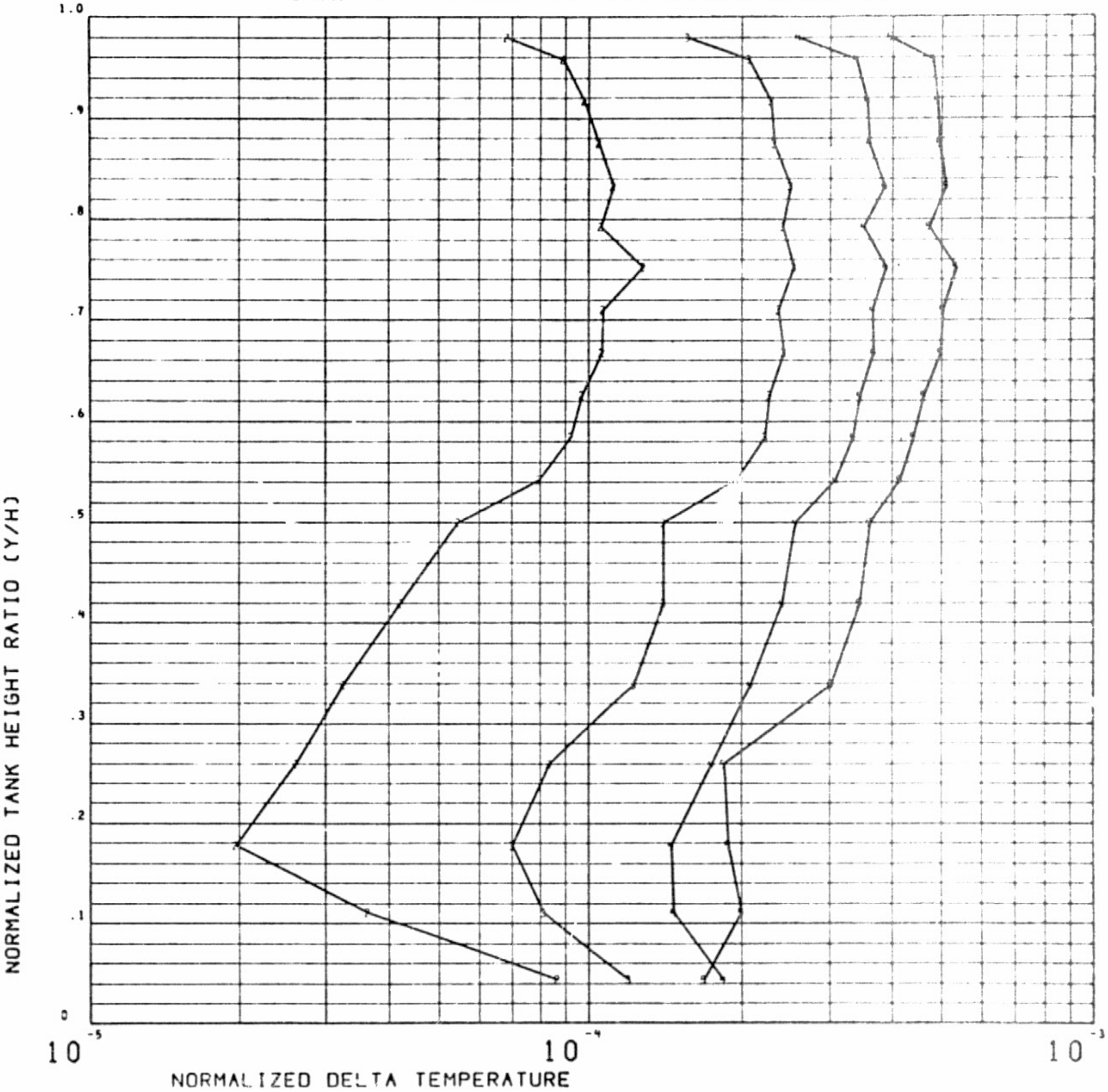


FIGURE 5.10-3b

18 IN. TNK TST 1GΣIS STRAT DTNORM PROFILE

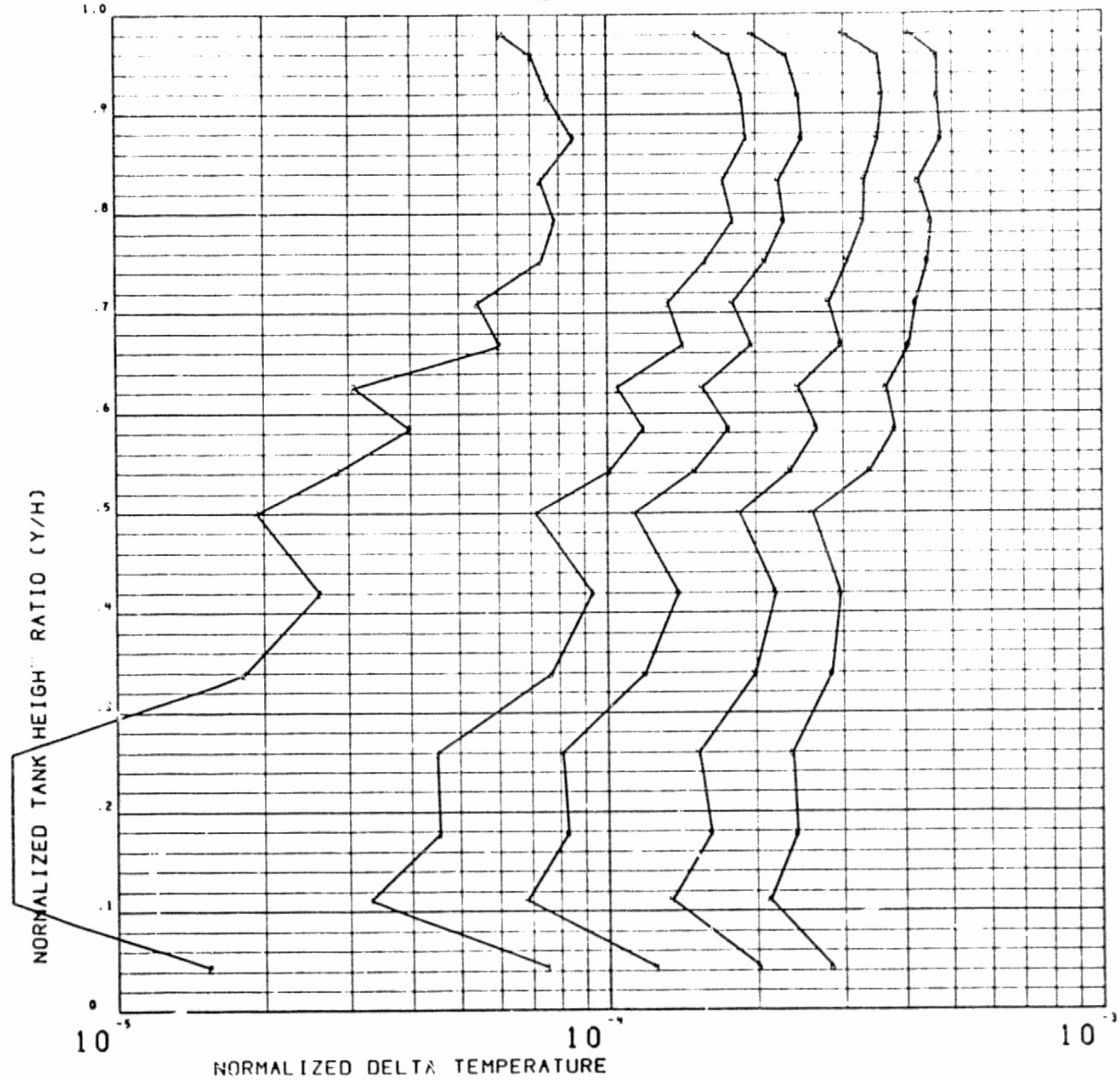


FIGURE 5.10-4a
6 IN. TNK TST 27GΣ3S BULK ULGE γ LIQ TEMP HISTORIES

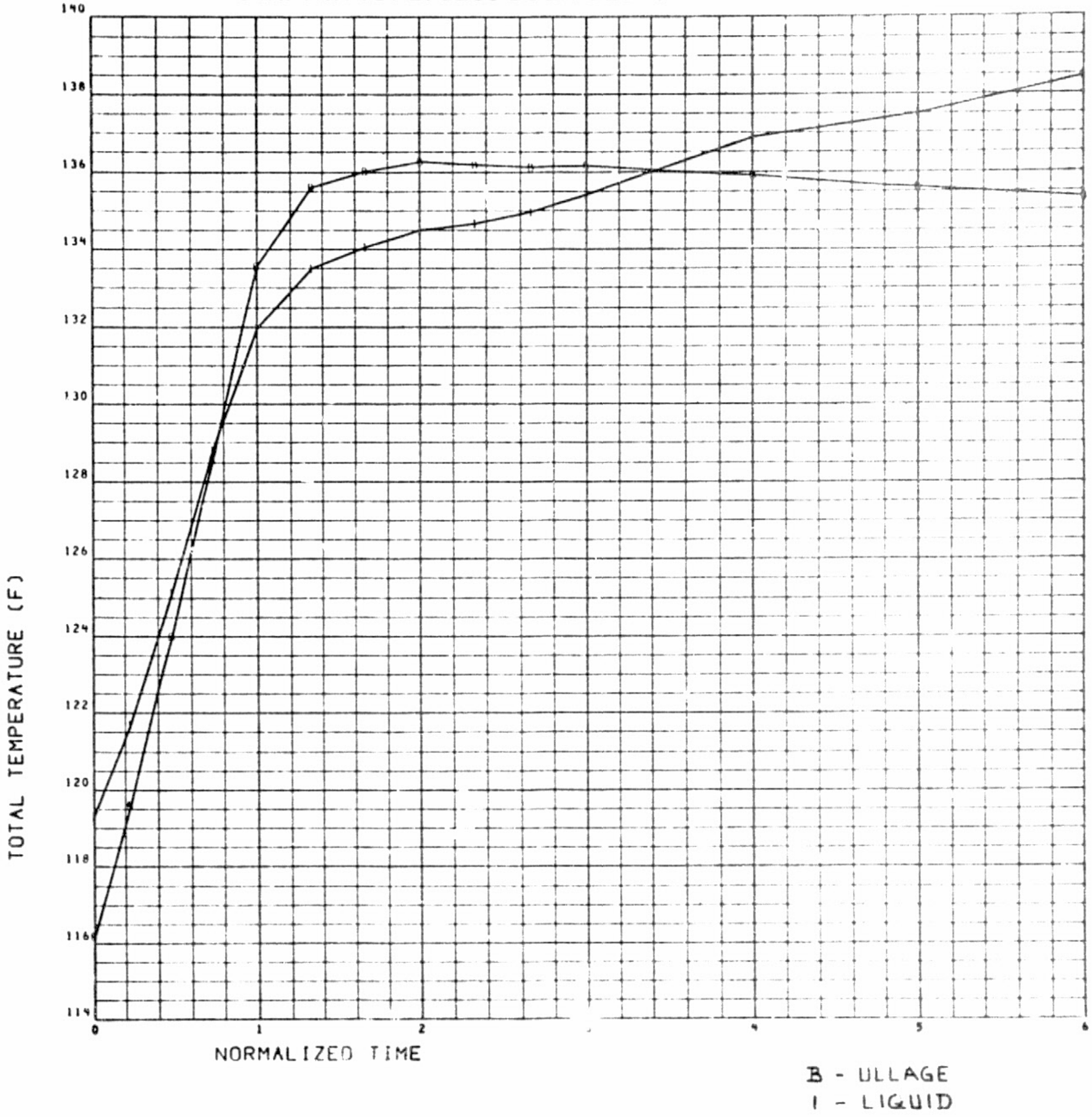


FIGURE 5.10-4b
18 IN. TNK TST 1GΣIS BULK ULGE γLIQ TEMP HISTORIES

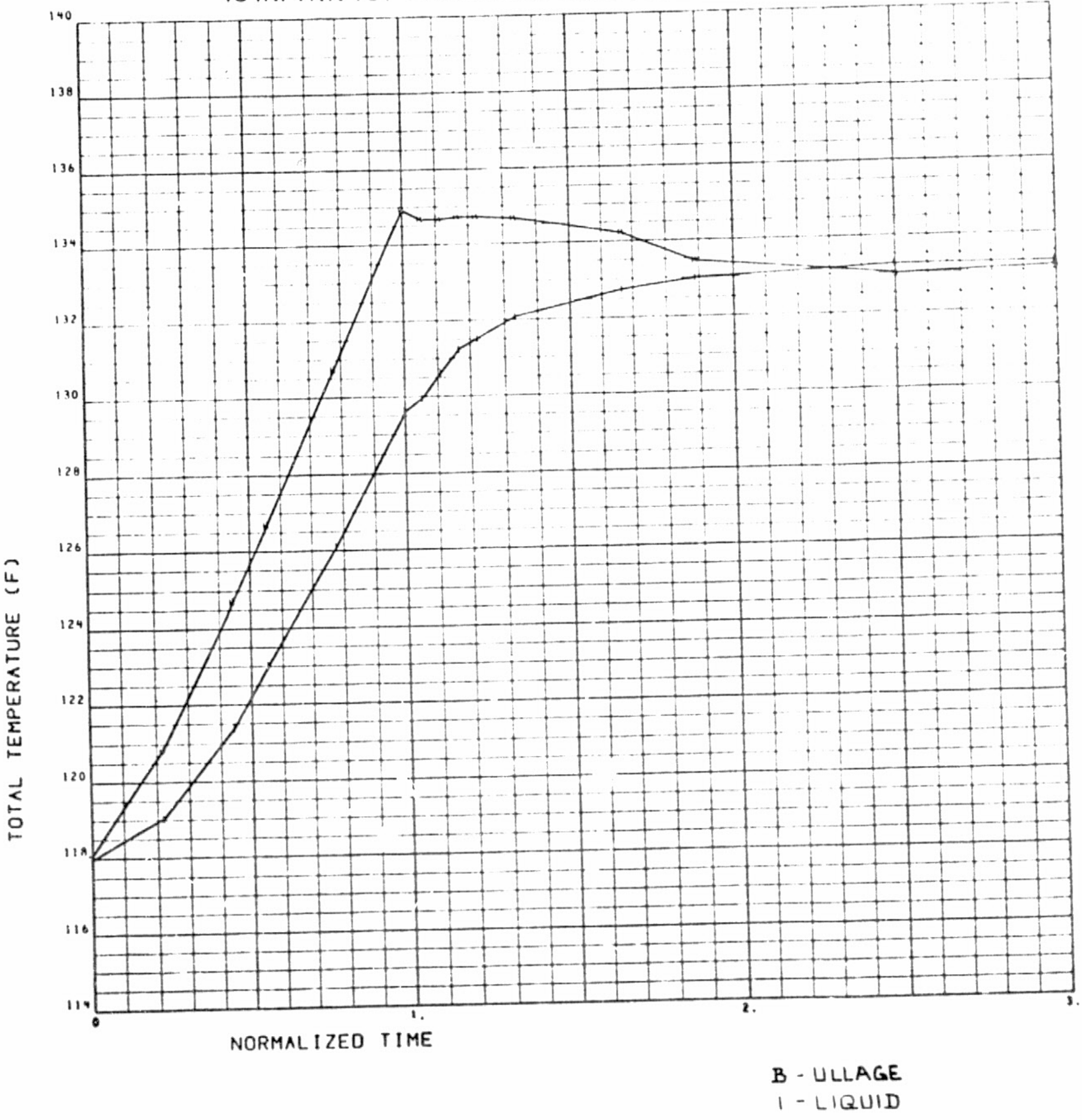
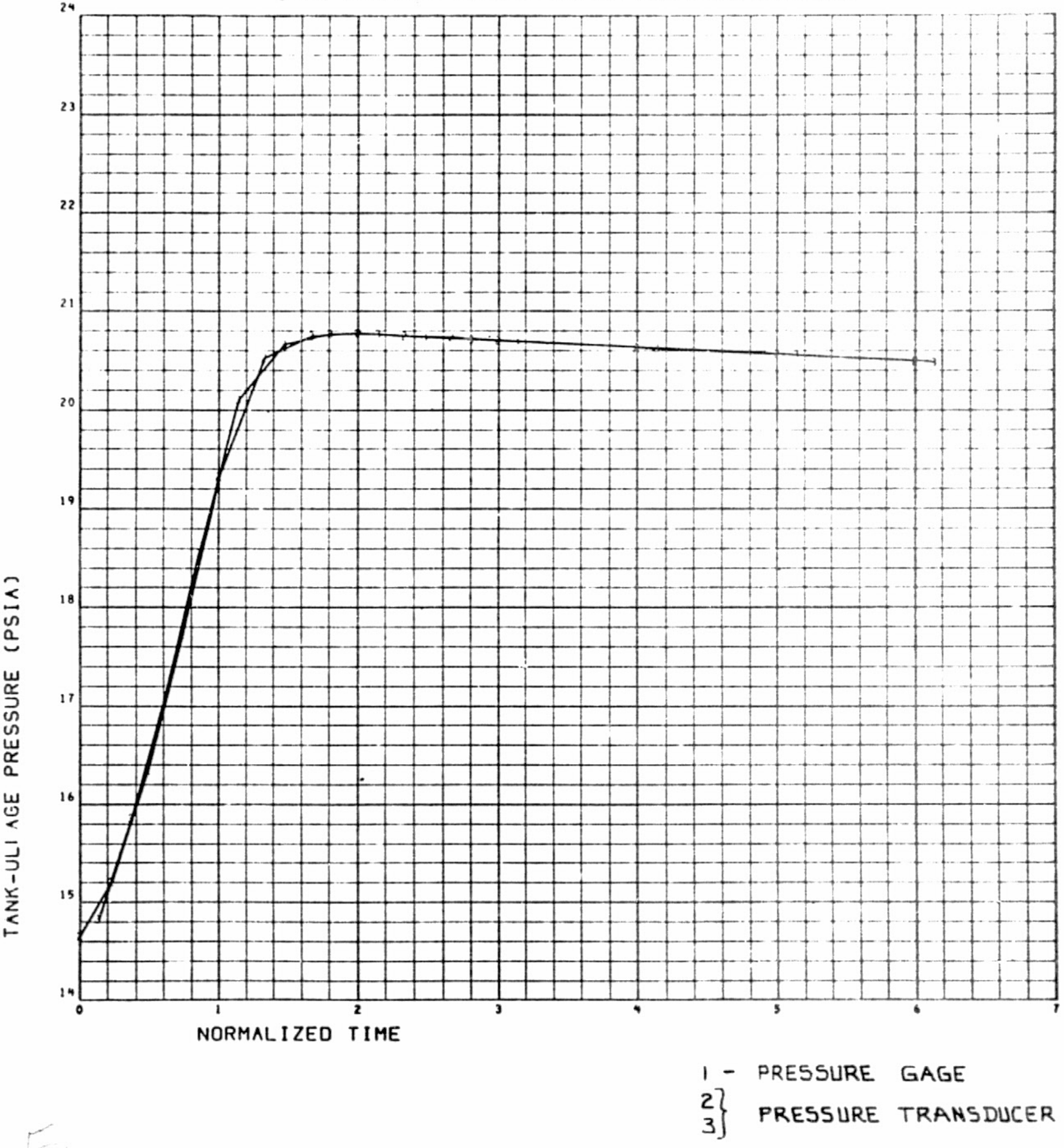


FIGURE 5.10-5a
6 IN. TNK TST 27GΣ3S TANK PRESSURE HISTORY



C5

FIGURE 5.10-5b

18 IN. TNK TST 1GΣIS TANK PRESSURE HISTORY

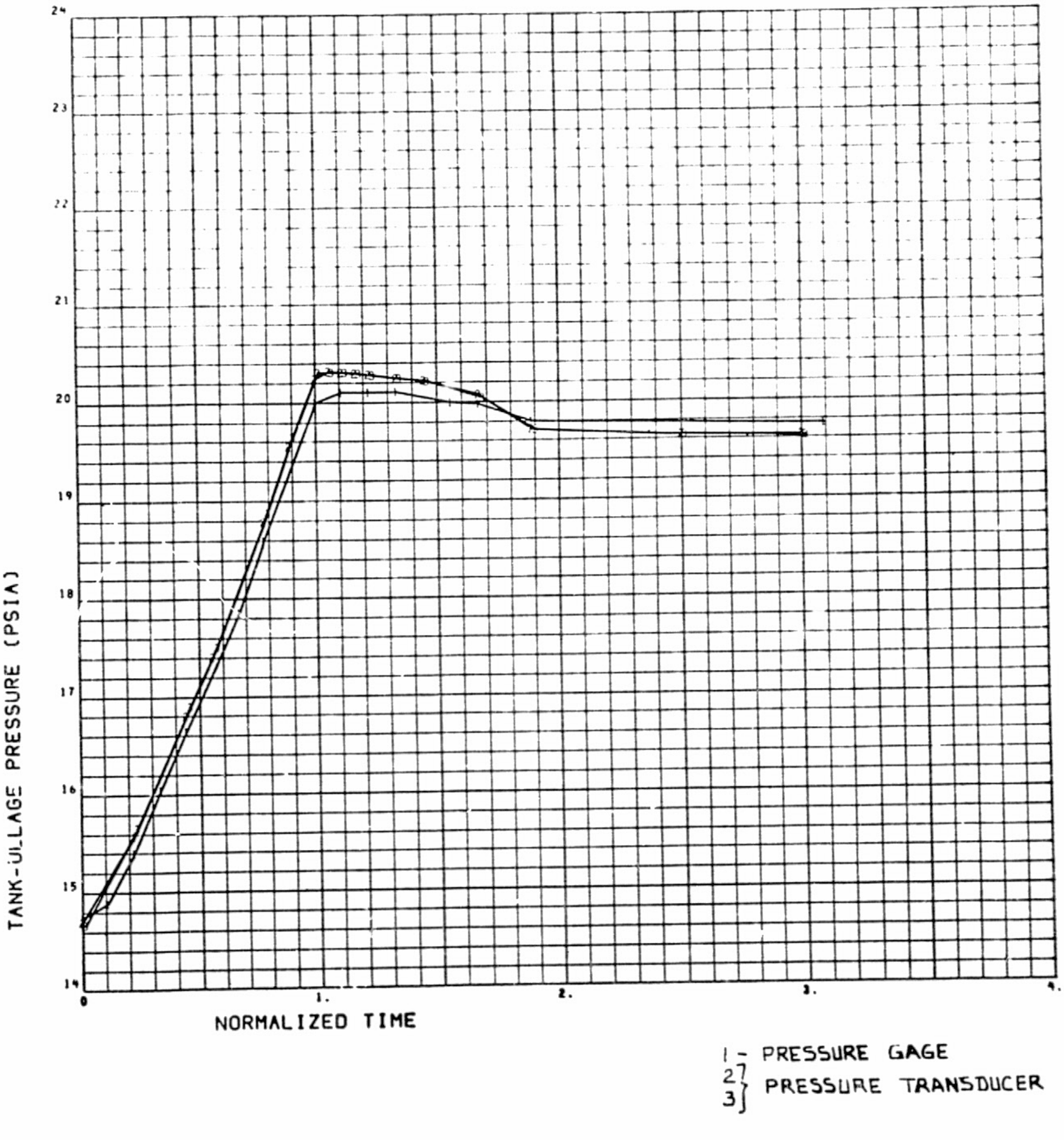
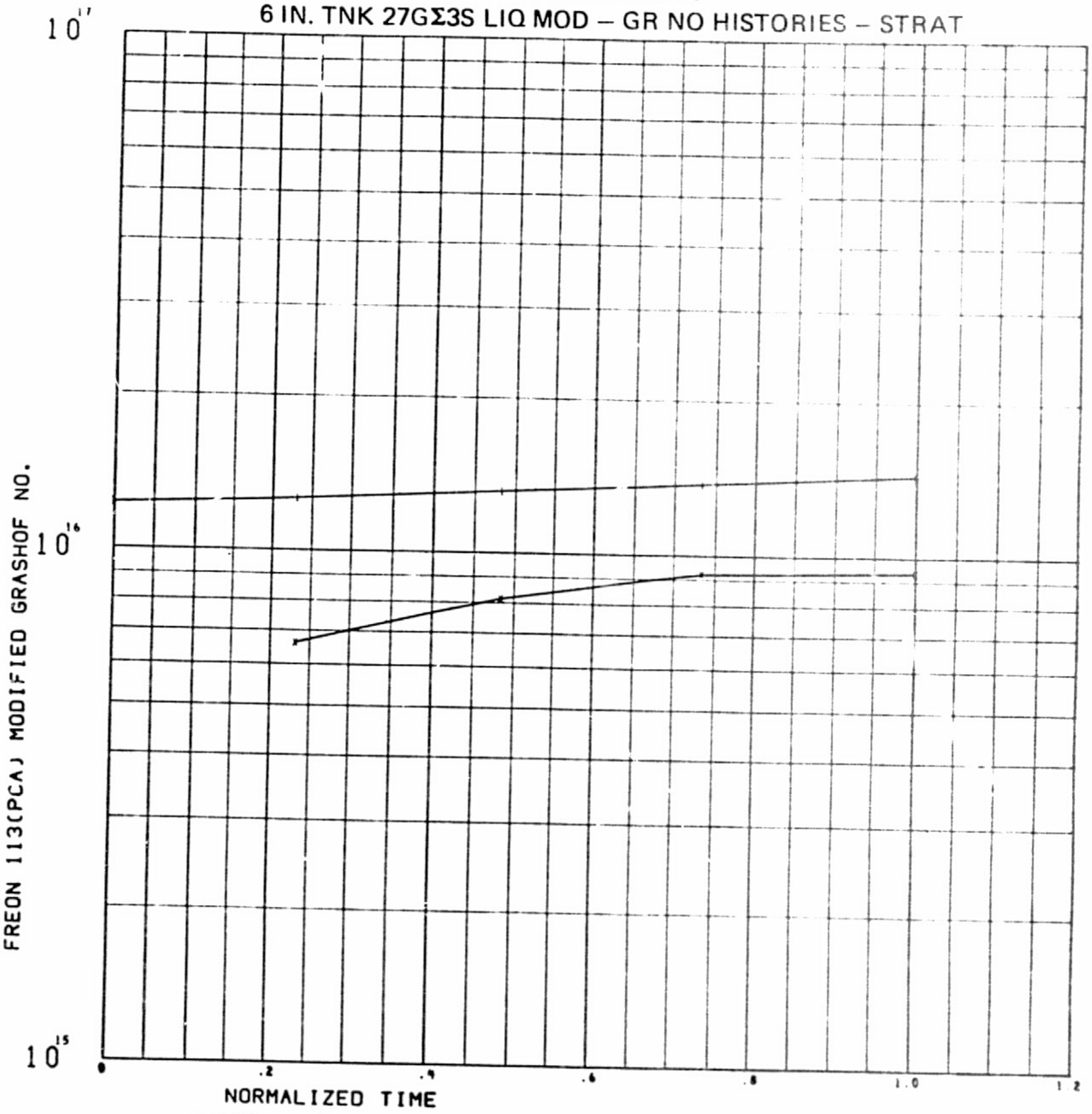


FIGURE 5.10-6a

6 IN. TNK 27GΣ3S LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g \beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''_\ell L}{k}\right)$$

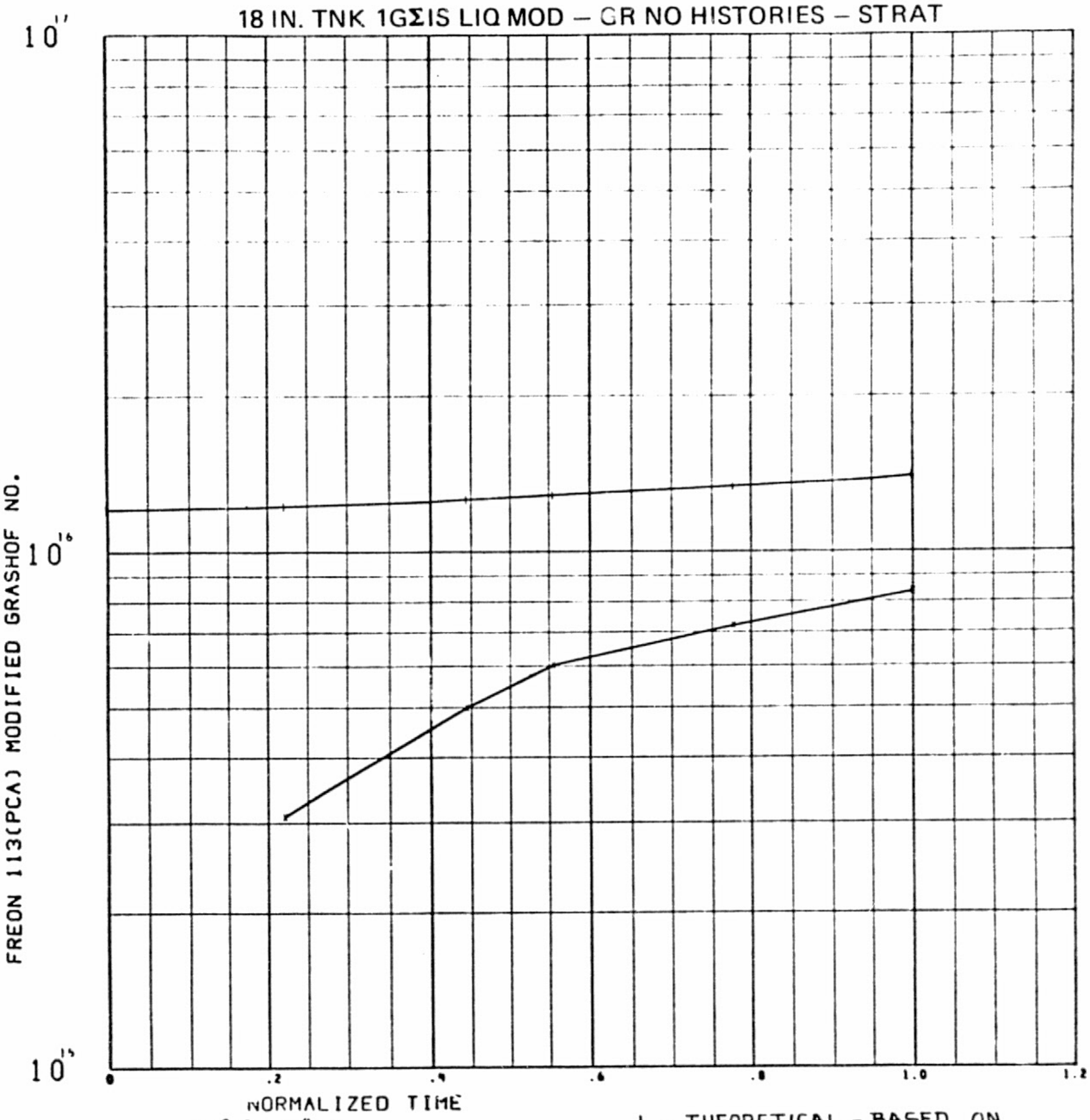
L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL - BASED ON MEASURED q''_H WATTAGE INPUT

X - EXPERIMENTAL - BASED ON MEASURED q''_ℓ FLUID

FIGURE 5.10-6b

18 IN. TNK 1GΣIS LIQ MOD – GR NO HISTORIES – STRAT



$$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{K}\right)$$

L = FLUID (FREON PCA (113)) DEPTH

I - THEORETICAL - BASED ON MEASURED q''_H WATTAGE INPUT

X - EXPERIMENTAL - BASED ON MEASURED q''_ℓ FLUID

FIGURE 5.10-7a

6 IN. TNK 27GΣ3S LIQ FOURIER NO HISTORY

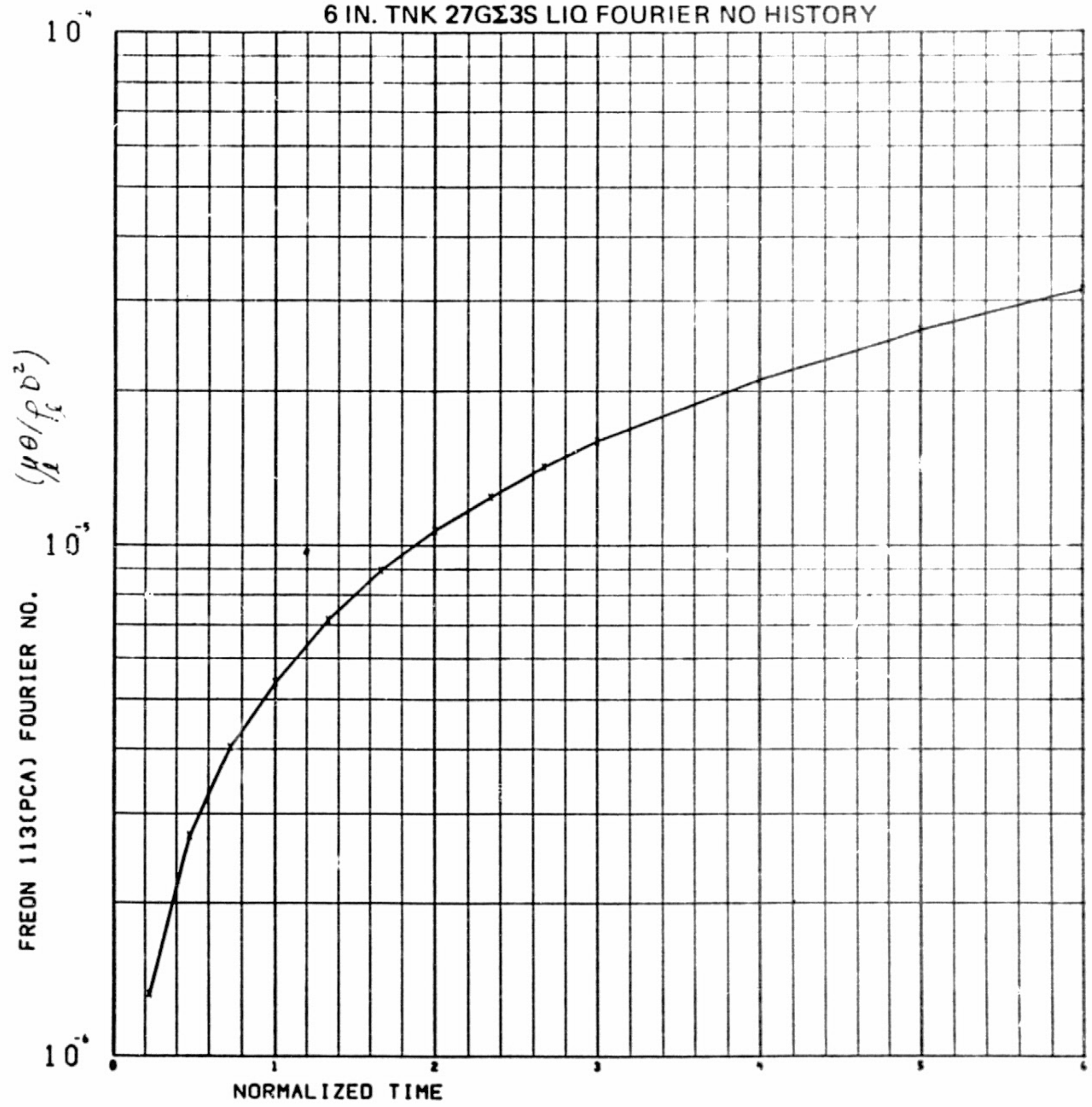
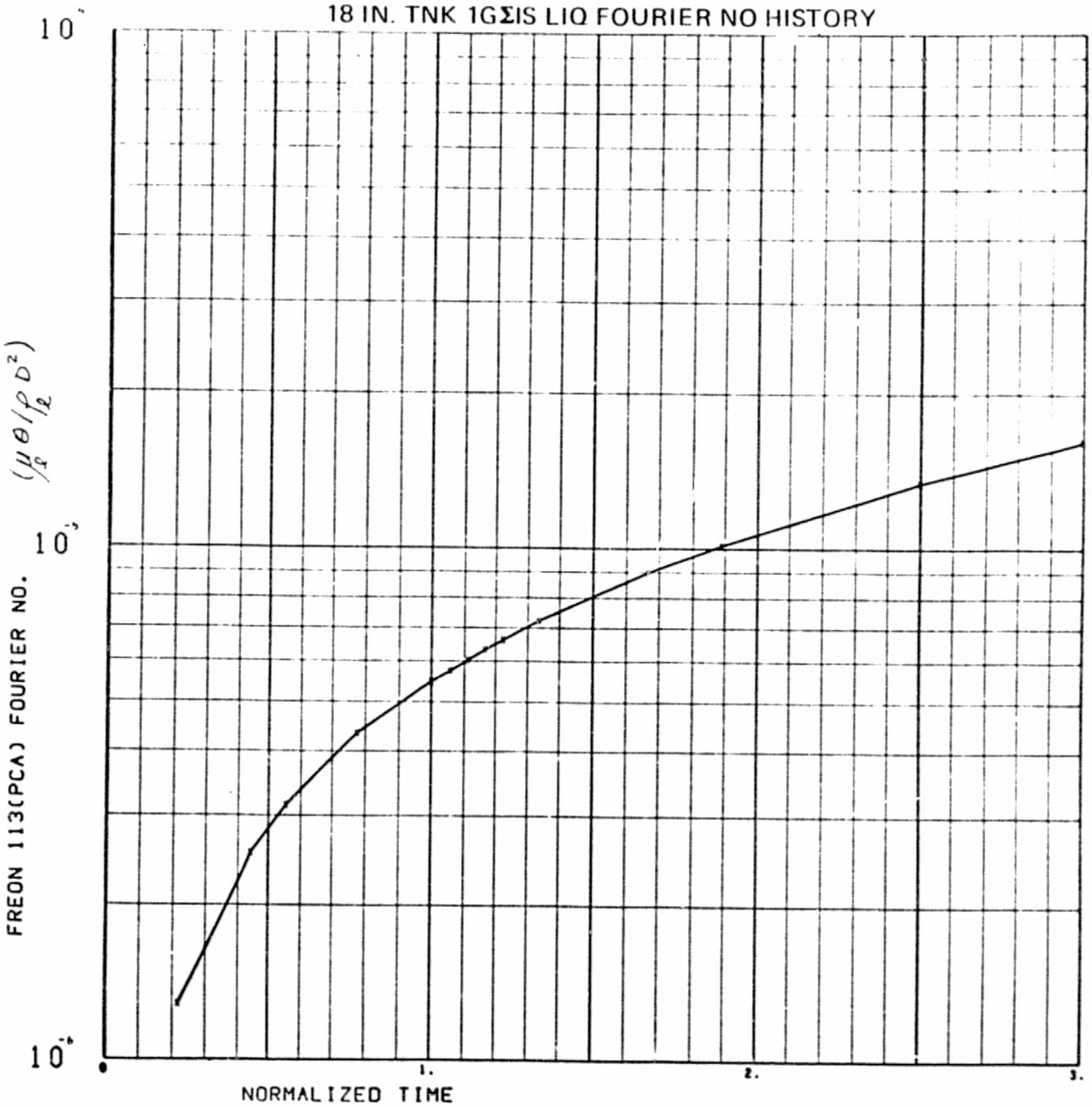


FIGURE 5.10-7b
18 IN. TNK 1GΣIS LIQ FOURIER NO HISTORY



Section 5.11

CONSTANT WALL HEATER HEAT FLUX TESTS

$q''_H = 600$ Btu/hr ft^2

6-in.-Dia Tank Tests
1G
Test #1 Test #2

Note: c.f. 6-in.-Dia Tank Test 8G #1 (Section 5.5)

Table 5.11-1a. 6 IN. DIA. TANK TEST 1G#1

```
            STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    ,3927       CYL AREA FT2=  1,5708       FLNGE AREA FT2=    ,0365
DME WALL VOL FT3=    ,00131       1/2 CYL WALL VOLFT3=    ,00164     FLNGE VOL FT3=     ,00076
DME MASS LBM=    ,65596      MASS 1/2 CYL LBM=     ,81996      FLANGE MASS=    ,38058

 LIQ VOL FT3=    ,22907       ULLAGE VOL FT3=     ,03272

 INPUT HEAT FLUXES (BTU/HR=FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 600,8488    H34= 600,8488    H56= 600,8488    H910= 600,8488    H78=    0,0000

EST,HT FLUX IN LIQ (BTU/HR=FT2)= 600,8488
EST,HT FLUX IN ULLGE (BTU/HR=FT2)=    0,0000
EST,HT INPUT LIQ(STRAT)BTU=    72,752      (STRAT+DESTRAT)BTU=  137,639
EST,LIQ TEMP INCRSE(STRAT)=    14,9311F      (STRAT+DESTRAT)=    28,2232F

EST,HT INPUT ULLAGE(STRAT)BTU=      0,000      (STRAT+DESTRAT)BTU=     0,000
```

Table 5.11-1b. 6 IN. DIA. TANK TEST 1G#2

```
            STRUCTURAL GEOMETRIC TANK WTS=WATTMETER HEAT FLUX  INPUTS

 DOME AREA FT2=    ,3927       CYL AREA FT2=  1,5708       FLNGE AREA FT2=    ,0365
DME WALL VOL FT3=    ,00131       1/2 CYL WALL VOLFT3=    ,00164     FLNGE VOL FT3=     ,00076
DME MASS LBM=    ,65596      MASS 1/2 CYL LBM=     ,81996      FLANGE MASS=    ,38058

 LIQ VOL FT3=    ,22907       ULLAGE VOL FT3=     ,03272

 INPUT HEAT FLUXES (BTU/HR=FT2),AND ABSORBED HEAT AND TEMPERATURE ESTIMATES

H12= 600,8488    H34= 600,8488    H56= 600,8488    H910= 600,8488    H78=    0,0000

EST,HT FLUX IN LIQ (BTU/HR=FT2)= 600,8488
EST,HT FLUX IN ULLGE (BTU/HR=FT2)=    0,0000
EST,HT INPUT LIQ(STRAT)BTU=    72,752      (STRAT+DESTRAT)BTU=  137,639
EST,LIQ TEMP INCRSE(STRAT)=    14,9301F      (STRAT+DESTRAT)=    28,2167F

EST,HT INPUT ULLAGE(STRAT)BTU=      0,000      (STRAT+DESTRAT)BTU=     0,000
```

Table 5.11-2a. 6 IN. DIA TANK TEST 1G #1 (Page 1 of 2)

TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0,000	1,000	2,000	3,000	3,700
TAU	0,000	.270	.541	.811	1,000
1	115,819	123.625	128,750	133,389	136,083
2	116,500	130.750	136,375	141,208	143,625
3	116,667	128.750	134,250	138,667	141,250
4	116,750	129.333	134,250	138,292	140,833
5	116,375	127.000	132,083	135,500	137,958
6	116,417	128.000	132,375	135,875	137,917
7	116,500	129.500	133,208	136,375	138,333
8	116,542	128.375	131,792	134,667	136,417
9	115,958	121.458	124,875	127,958	129,750
10	116,333	133.792	139,167	143,417	146,250
11	116,583	134.458	139,458	142,958	145,792
12	116,917	133.583	137,667	141,000	142,958
13	116,375	132.500	135,792	138,708	140,375
14	115,708	122.458	127,458	132,167	134,917
15	116,042	125.958	131,333	135,833	138,417
16	116,417	126.167	131,333	135,250	137,833
17	116,250	124.125	128,167	131,625	134,000
18	115,708	124.375	127,708	130,750	132,792
19	115,333	119.583	123,083	126,125	127,875
20	116,333	133,792	139,167	143,417	146,250
21	116,583	134.458	139,458	142,958	145,792
22	116,917	133.583	137,667	141,000	142,958
23	116,375	132.500	135,792	138,708	140,375
24	115,458	117.250	120,875	124,917	127,458
25	113,125	115.958	117,958	120,458	122,083
26	105,875	109,875	113,542	115,250	116,292
27	99,583	100.958	104,167	106,250	107,125
28	114,958	115.750	117,208	119,042	120,625
29	115,042	115.875	117,333	119,708	121,500
30	115,542	117.583	121,208	125,375	128,042
31	115,681	120.861	132,528	134,944	136,750
32	116,292	130.333	133,000	135,333	136,917
33	112,750	117.500	120,458	122,500	123,833
34	108,583	108.625	109,250	110,208	110,917

Table 5.11-2a. 6 IN. DIA TANK TEST 1G #1 (Page 2 of 2)

35	104,375	103.708	103,250	103.208	103,292
36	115,375	129.625	132,292	134,750	136,667
37	115,542	116.667	118,625	121.167	123,125
38	115,583	117.125	119,792	122,875	125,167
39	115,958	118.042	121,667	125,750	128,500
40	116,417	119.375	123,708	127,958	130,708
41	116,500	119.708	123,667	128,042	130,625
42	116,708	119.917	124,708	128,917	131,458
43	116,792	120.417	125,083	129,292	131,792
44	116,958	120.542	124,417	128,375	130,875
45	116,667	120.458	124,625	128,958	131,583
46	116,750	120.750	124,458	128.542	131,417
47	116,750	121.458	125,250	129,083	131,792
48	116,667	119.667	123,306	127,569	130,083
49	116,833	119.625	122,944	127,097	129,542
50	117,000	119.583	122,583	126,625	129,000
51	116,625	119.042	122,667	126,500	128,667
52	140,792	139.042	129,792	146,792	139,125
53	116,750	119.167	122,667	126,958	129,042
54	116,917	119.000	121,833	126,000	128,208
55	116,708	119.458	123,042	126.917	129,042
56	116,917	119.000	121,833	126.000	128,208
57	116,708	119.458	123,042	126.917	129,042
58	116,646	118.875	122,250	125,979	128,188
59	116,667	118.708	121,833	125.458	127,708
60	116,917	118.750	121,625	125,333	127,375
61	116,500	117.667	120,000	123,583	125,625
62	116,500	117.917	120,375	123,917	125,750
63	116,500	118.042	120,542	123,833	125,750
64	116,667	117.958	120,583	123,708	125,708
65	116,292	117.250	119,458	122,667	124,333
66	116,333	116.958	118,583	121,375	122,958
67	116,458	116.958	118,708	121,583	123,167
68	116,500	116.875	118,208	120,917	122,292
69	116,250	116,667	118,167	120,958	122,333
70	115,750	116.458	117,792	120,500	121,833
71	115,625	116.375	118,000	120,417	121,833
72	115,542	116.750	118,375	120,958	122,292
73	115,333	117.375	119,167	121,042	122,542
74	105,875	107.083	108,750	111,208	112,333
75	90,500	90.833	90,583	91,208	91,125
76	103,000	103.458	104,458	106,083	106,792
77	89,750	90.042	89,750	90,125	89,833

Table 5.11-2b. 6 IN. DIA TANK TEST 1G #2 (Page 1 of 2)

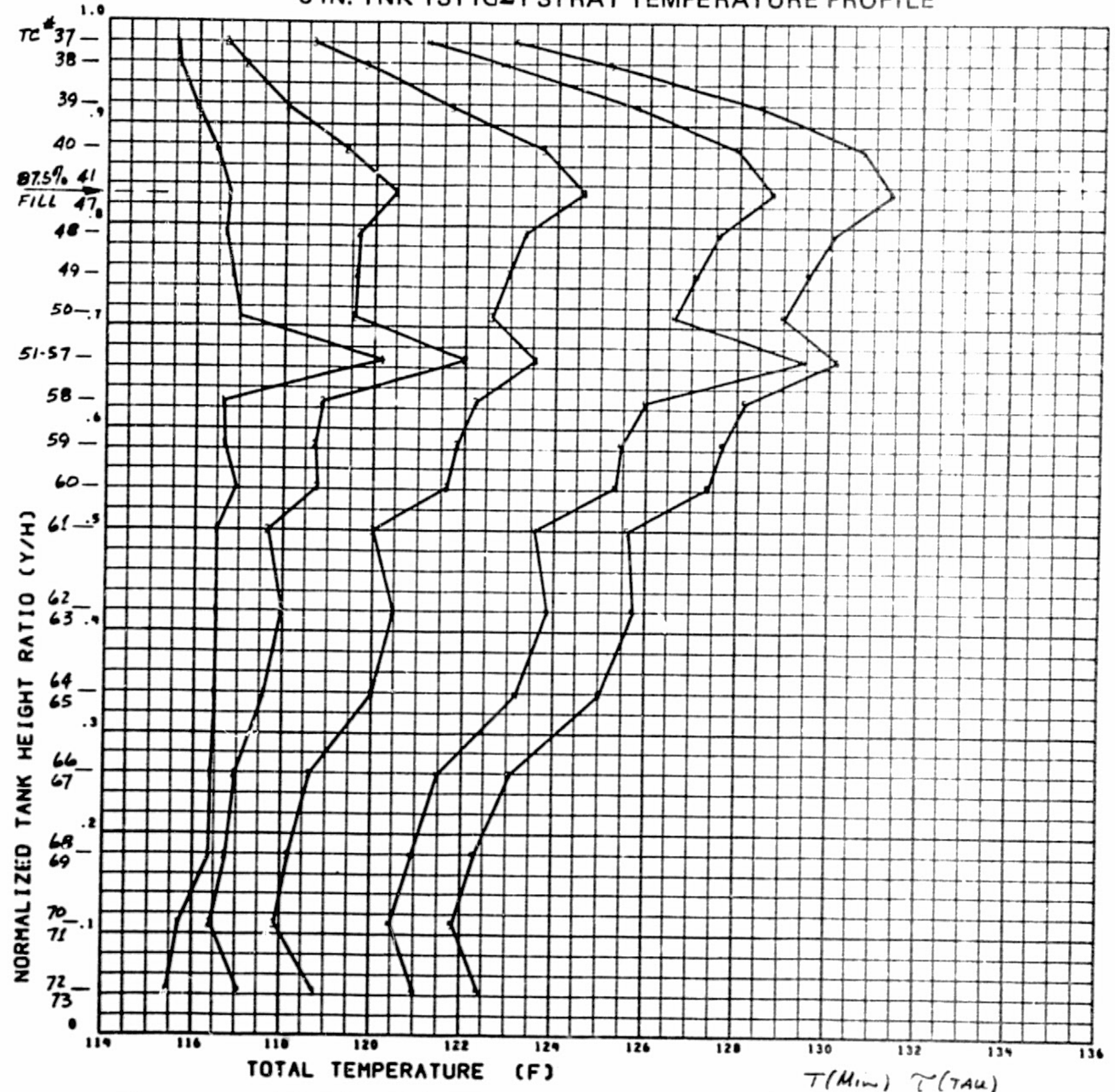
TEMPERATURE MATRIX-STRATIFICATION

TIME(MIN)	0.000	1,000	2,000	3,000	3,700
TAU	0.000	,270	,541	.811	1,000
1	116,750	124,167	129,125	133,375	135,958
2	117,333	130,500	136,167	140,500	142,917
3	117,500	129,708	134,833	138,167	140,708
4	117,375	128,958	133,771	137,125	139,500
5	117,250	128,208	132,708	136,083	138,292
6	117,208	128,750	133,000	136,208	138,417
7	117,333	128,875	132,896	135,833	137,771
8	117,458	129,000	132,792	135,458	137,125
9	116,375	122,000	125,583	128,500	130,208
10	117,333	134,333	139,708	143,500	146,500
11	117,500	135,250	140,292	144,208	146,292
12	117,667	134,250	138,125	141,375	143,500
13	117,167	132,875	136,083	138,708	140,542
14	116,542	123,167	128,125	132,708	135,208
15	116,917	126,458	131,958	136,292	138,675
16	117,417	126,750	132,000	135,833	138,167
17	117,021	125,938	130,458	133,667	135,729
18	116,625	125,125	128,917	131,500	133,292
19	116,125	120,333	123,708	126,708	128,500
20	117,333	134,333	139,708	143,500	146,500
21	117,500	135,250	140,292	144,208	146,292
22	117,667	134,250	136,125	141,375	143,500
23	117,167	132,875	136,083	138,708	140,542
24	116,708	119,000	123,125	127,125	129,500
25	116,333	118,500	122,000	125,625	128,208
26	116,250	118,396	121,792	125,333	127,813
27	116,167	118,292	121,583	125,042	127,417
28	116,542	118,292	121,208	124,542	126,583
29	116,250	117,583	120,333	123,708	125,875
30	116,542	119,125	123,167	127,208	129,792
31	116,792	130,889	133,500	135,819	137,347
32	117,458	131,417	134,000	136,042	137,625
33	115,458	120,083	122,375	124,167	125,333
34	113,167	113,208	113,792	114,417	114,833

Table 5.11-2b. 6 IN. DIA TANK TEST 1G #2 (Page 2 of 2)

35	110,958	110,250	109,833	109,625	109,458
36	116,458	130,625	133,250	135,708	137,208
37	116,708	118,750	122,250	125,875	128,375
38	116,667	119,000	122,833	126,708	129,208
39	116,708	119,542	123,583	127,667	130,292
40	116,958	120,083	124,250	128,292	130,875
41	117,417	119,958	124,250	128,042	130,375
42	117,333	120,575	125,083	129,292	131,708
43	117,375	120,958	125,208	129,250	131,750
44	117,667	120,958	125,458	129,333	131,625
45	117,333	121,292	125,333	129,458	131,750
46	117,458	121,958	125,542	129,458	131,708
47	117,375	122,083	125,417	130,042	131,792
48	118,208	121,250	125,375	128,958	131,833
49	117,625	120,833	124,500	128,583	130,917
50	117,583	120,083	123,583	127,167	129,542
51	117,575	119,933	123,350	127,017	129,250
52	117,558	120,029	123,404	127,133	129,333
53	117,417	120,458	123,208	127,375	129,583
54	117,542	120,125	123,458	127,250	129,417
55	117,542	120,125	123,458	127,250	129,417
56	117,542	120,125	123,458	127,250	129,417
57	117,542	120,125	123,458	127,250	129,417
58	117,558	119,633	122,883	126,717	128,667
59	117,542	119,333	122,417	126,417	128,083
60	117,438	118,979	121,771	125,375	127,042
61	117,333	118,625	121,125	124,333	126,000
62	117,125	118,583	121,208	124,542	126,000
63	117,375	118,750	121,208	124,542	126,458
64	117,417	118,875	121,458	124,583	126,417
65	117,208	118,083	120,208	123,417	125,042
66	117,083	117,750	119,500	122,375	123,792
67	117,208	117,875	119,458	122,375	123,875
68	117,625	117,667	119,000	121,292	122,917
69	117,125	117,500	119,167	121,708	123,125
70	117,083	117,542	118,792	121,292	122,750
71	116,917	117,708	118,667	121,042	122,417
72	117,083	117,917	119,375	121,792	123,292
73	116,708	117,833	120,417	122,292	123,917
74	105,792	106,917	108,333	110,625	111,625
75	89,375	89,667	89,625	90,208	90,125
76	102,708	103,125	104,208	105,875	106,667
77	87,917	88,167	88,125	88,417	88,250

FIGURE 5.11-1a
6 IN. TNK TST1GΣ1 STRAT TEMPERATURE PROFILE



$\dot{q}''_H$ = 600 BTU/hr ft² LIQ HTG

	T(Min)	τ(TAU)
1	0.	0.
2	1.	.27
3	2.	.541
4	3.	.811
5	3.7	1.000

FIGURE 5.11-1b
6 IN. TNK TST1GΣ2 STRAT TEMPERATURE PROFILE

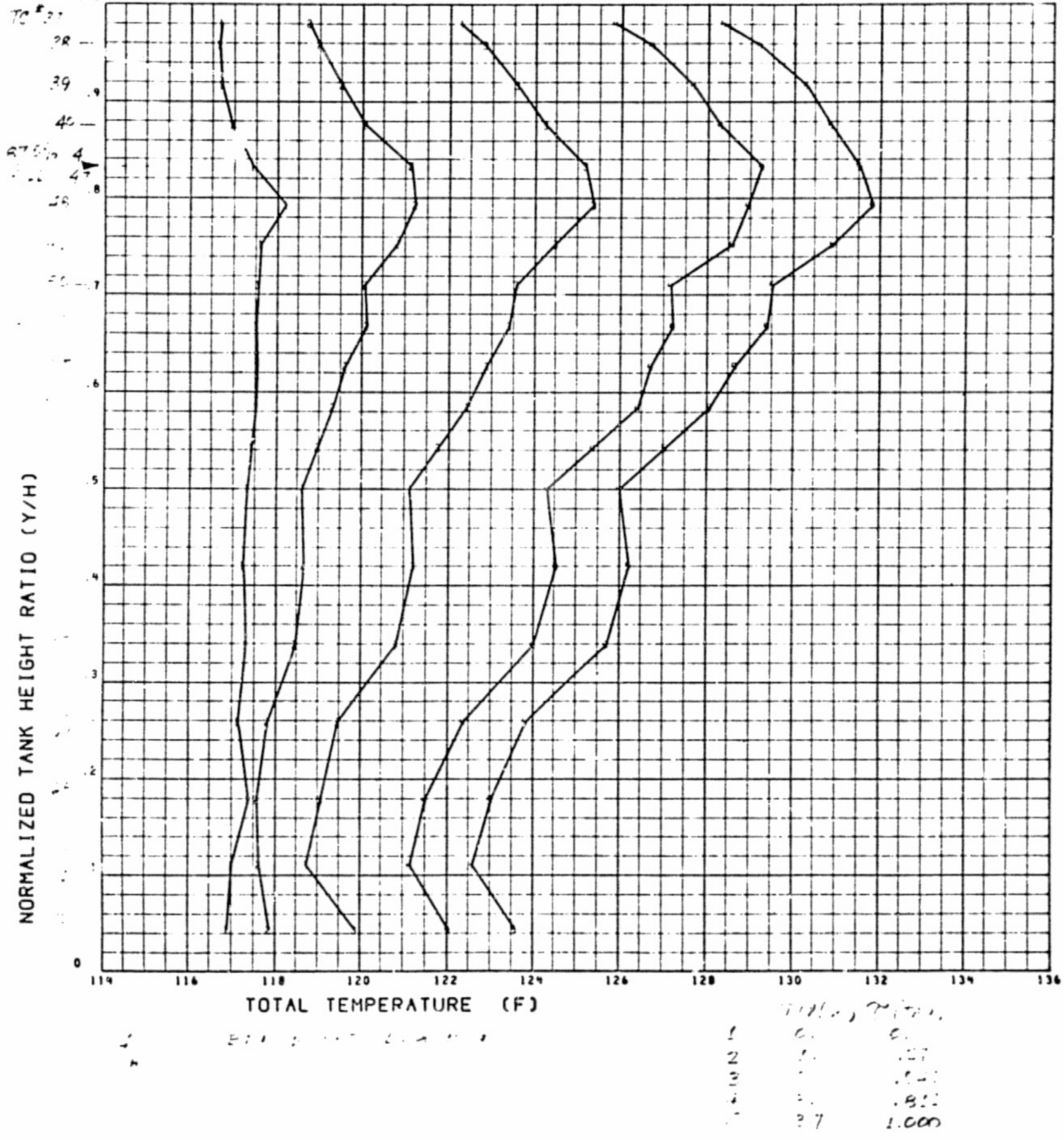


FIGURE 5.11-2a
6 IN. TNK TST1GΣ1 STRAT DEL – TEMP PROFILE

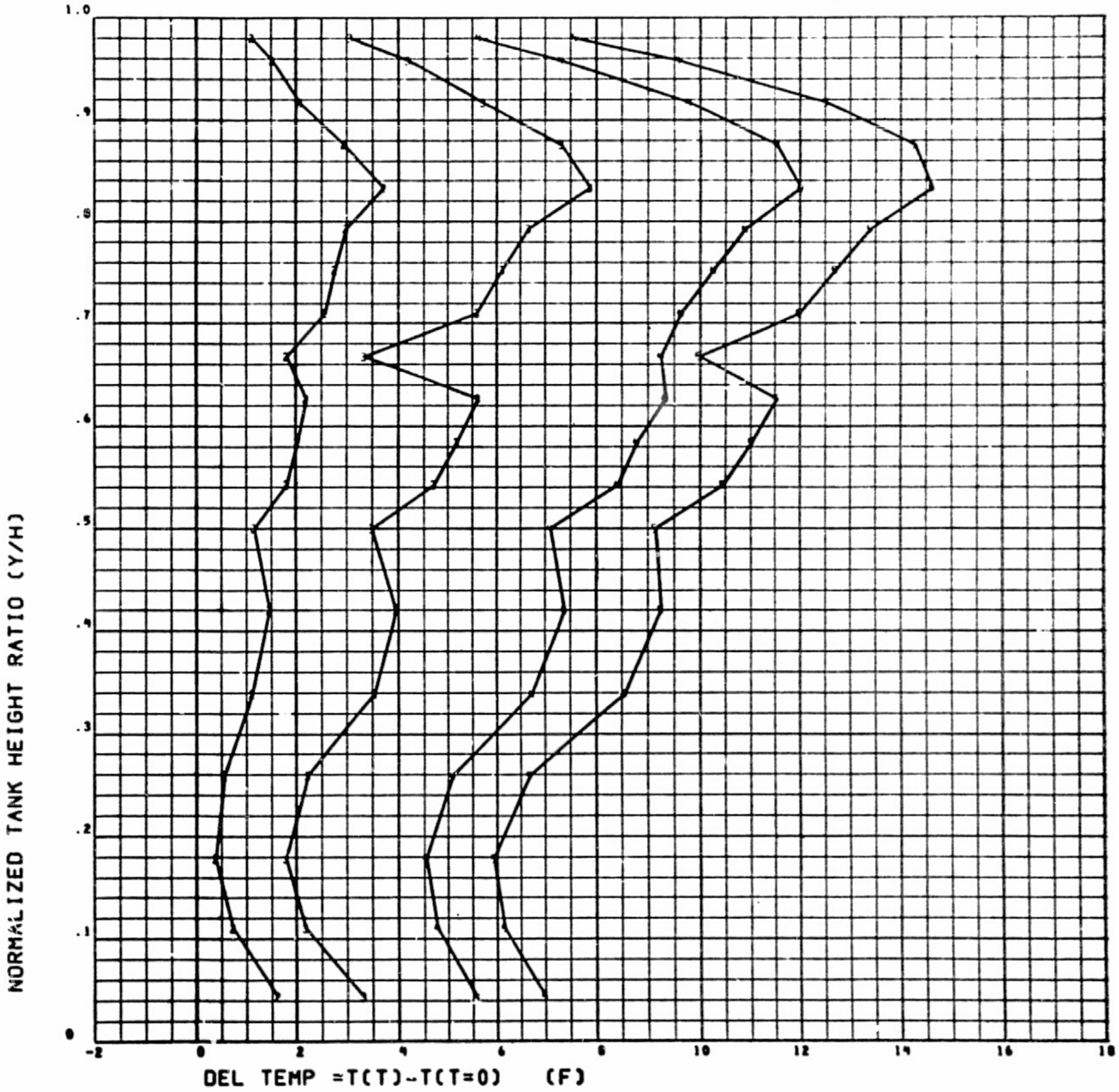


FIGURE 5.11-2b
6 IN. TNK TST1GΣ2 STRAT DEL – TEMP PROFILE

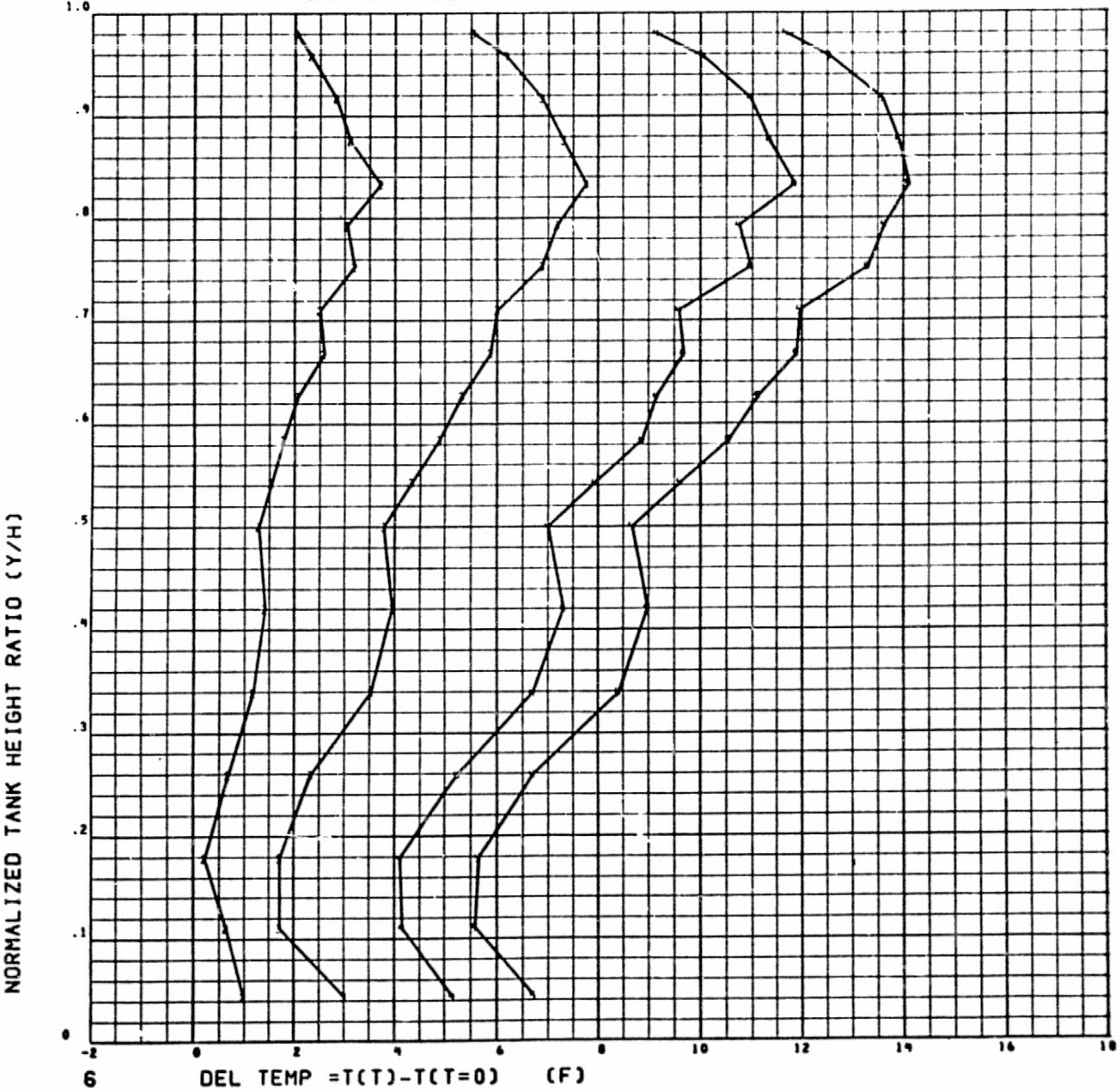


FIGURE 5.11-3a

6 IN. TNK TST1GΣ1 STRAT DTNORM PROFILE

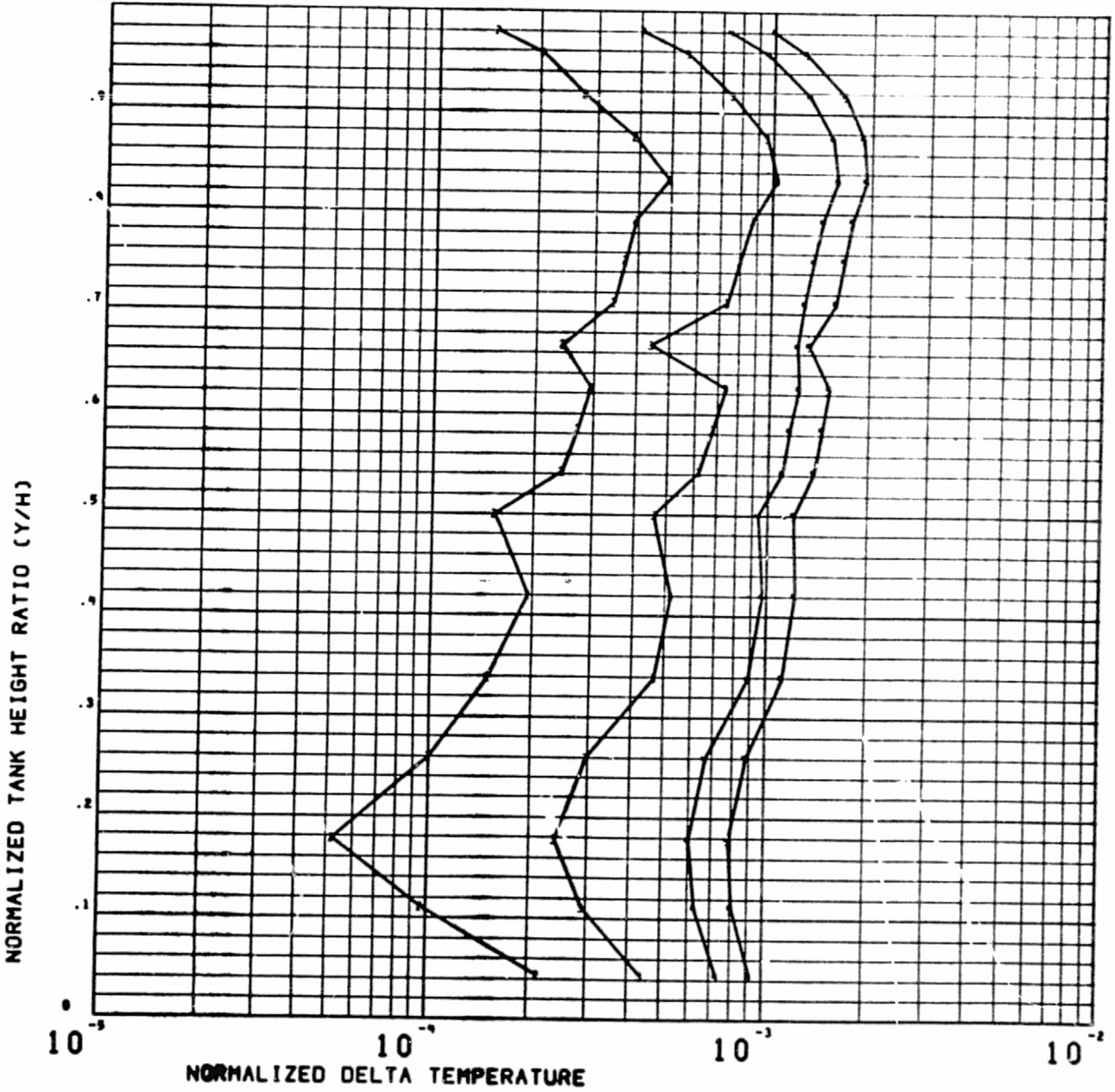


FIGURE 5.11-3b

6 IN. TNK TST1GΣ2 STRAT DTNORM PROFILE

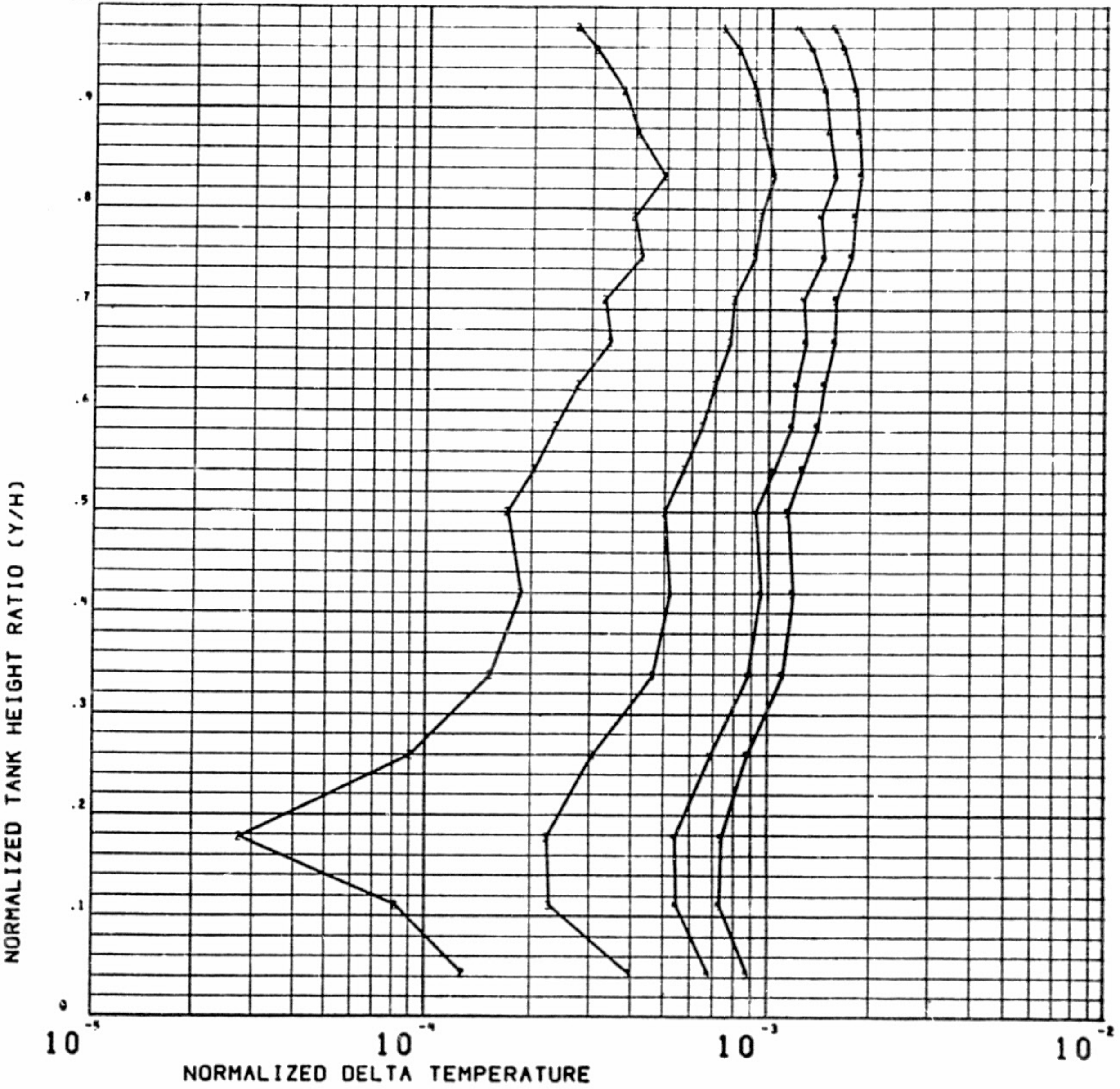


FIGURE 5.11-4a

6 IN. TNK TST1GΣ1 BULK ULGE γLIQ TEMP HISTORIES

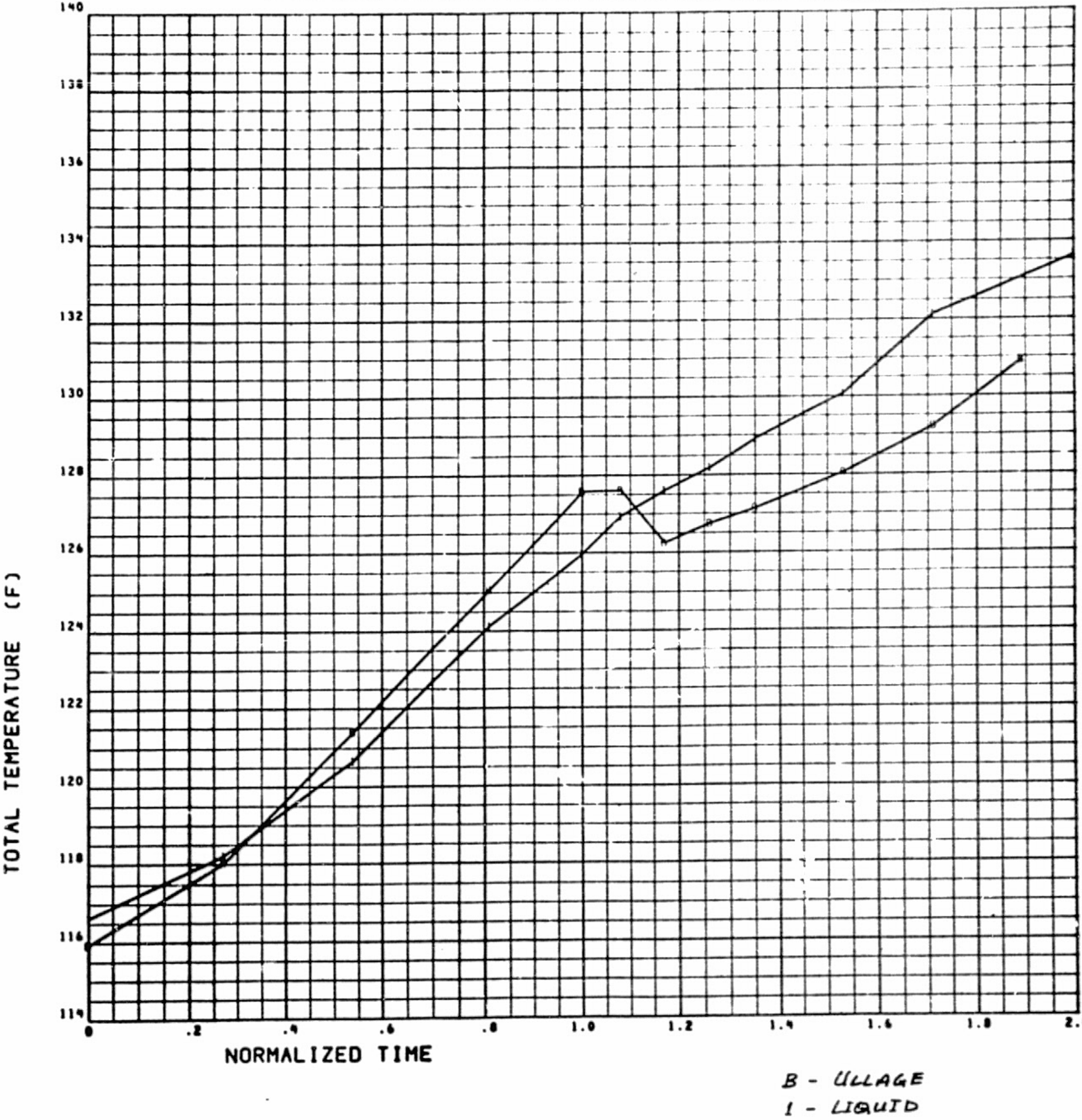
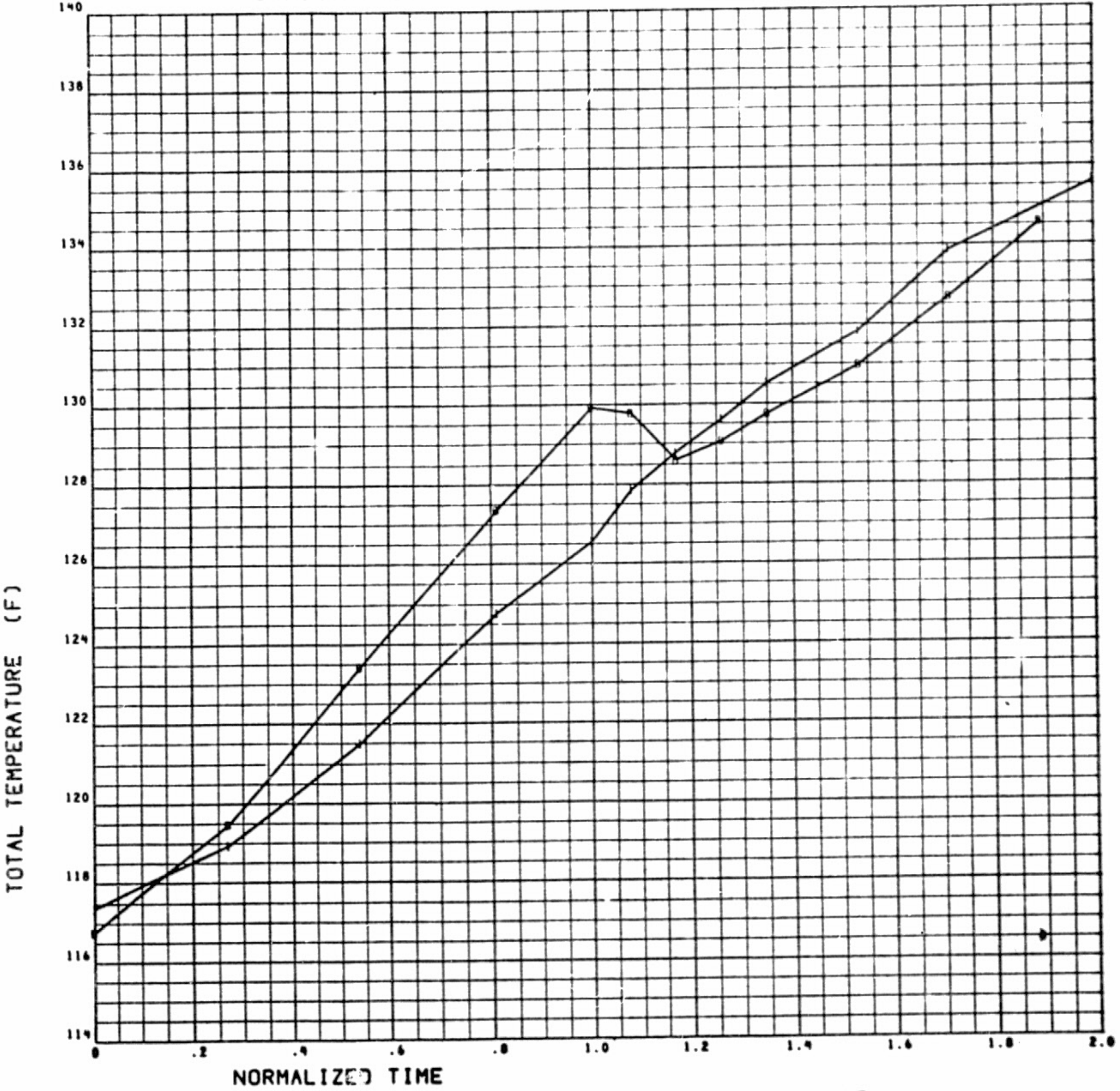


FIGURE 5.11-4b

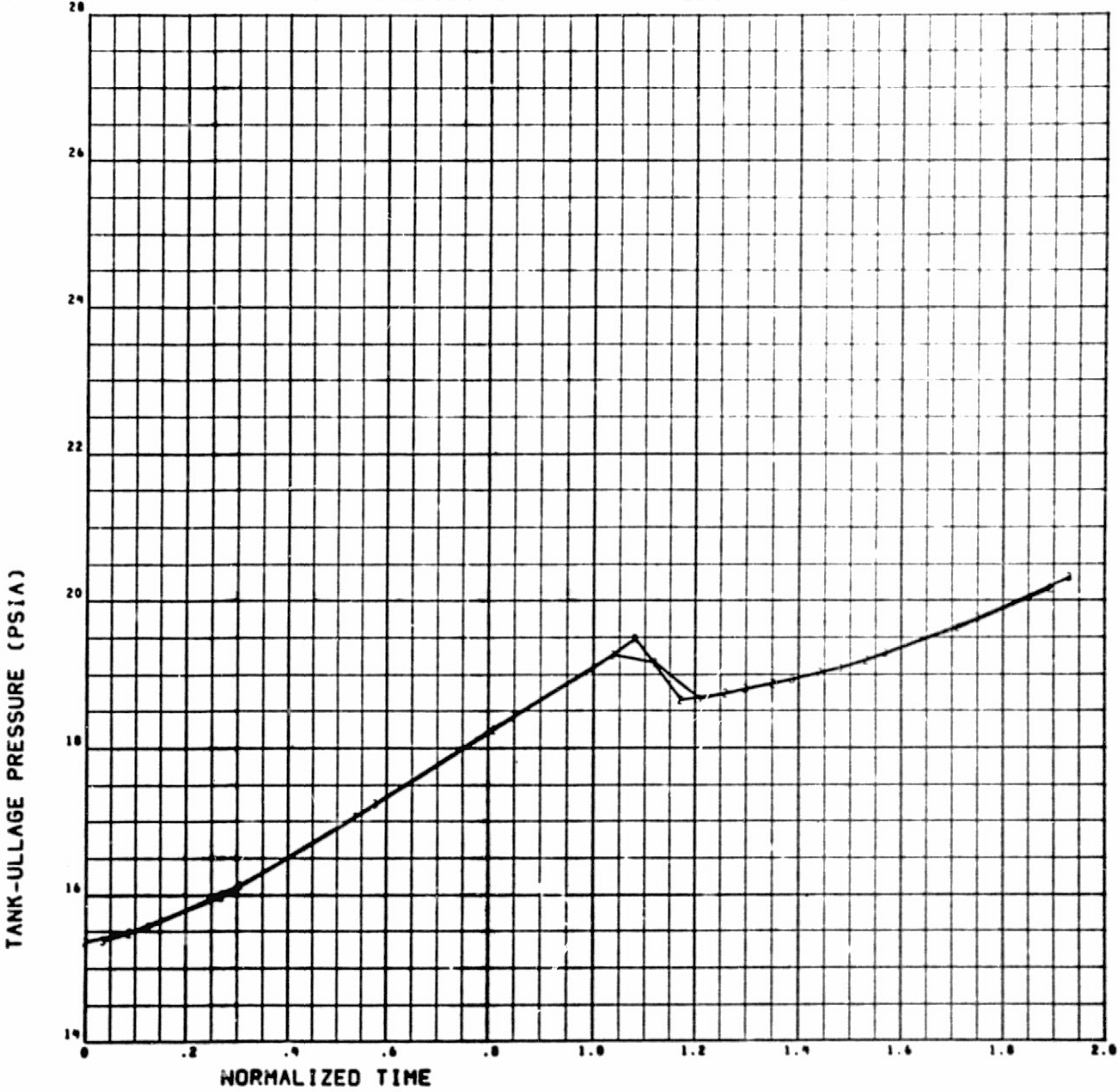
6 IN. TNK TST 1GΣ2 BULK ULGE ץ LIQ TEMP HISTORIES



B - ULLAGE
I - LIQUID

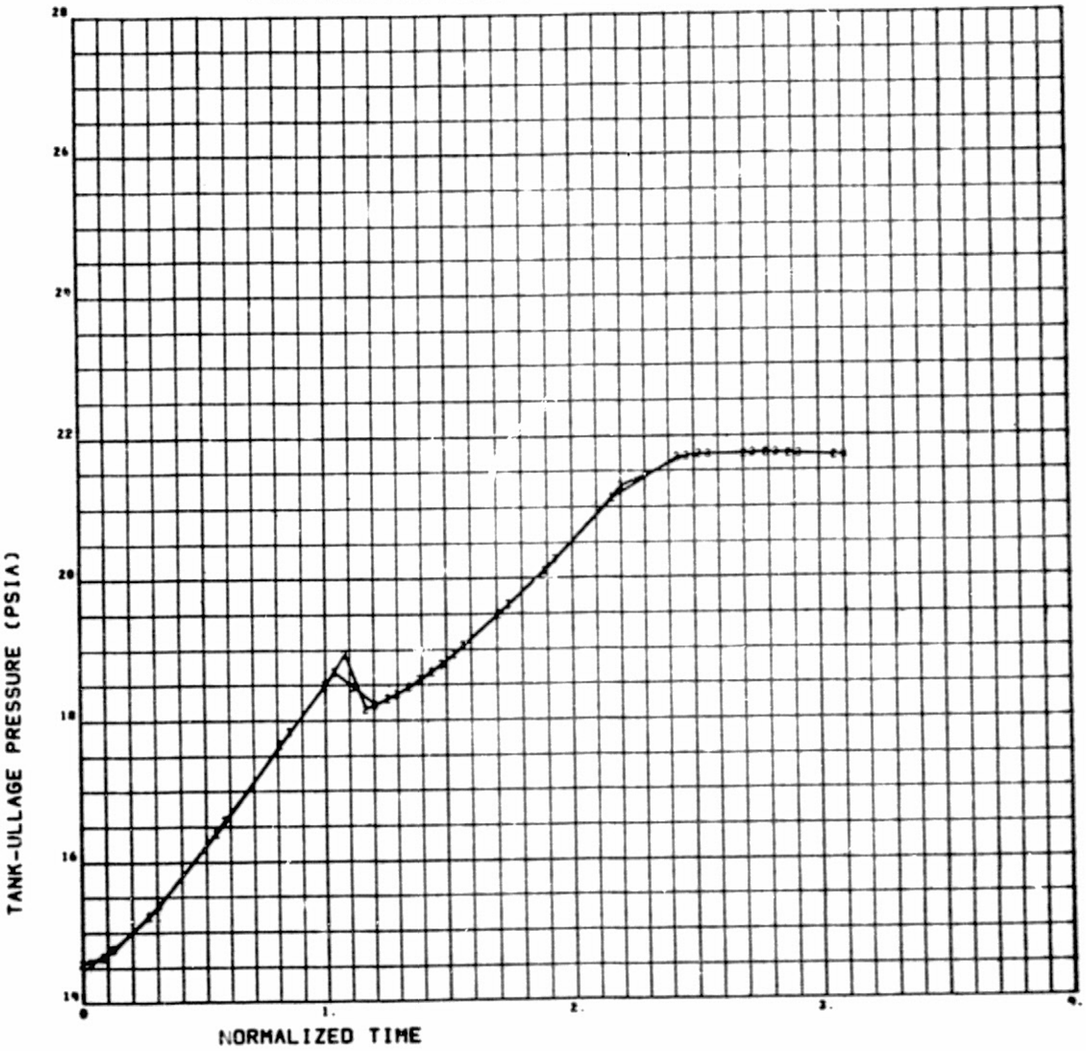
FIGURE 5.11-5a

6 IN. TNK TST1GΣ1 TANK PRESSURE HISTORY



2 - }
3 - } Transducer Measured

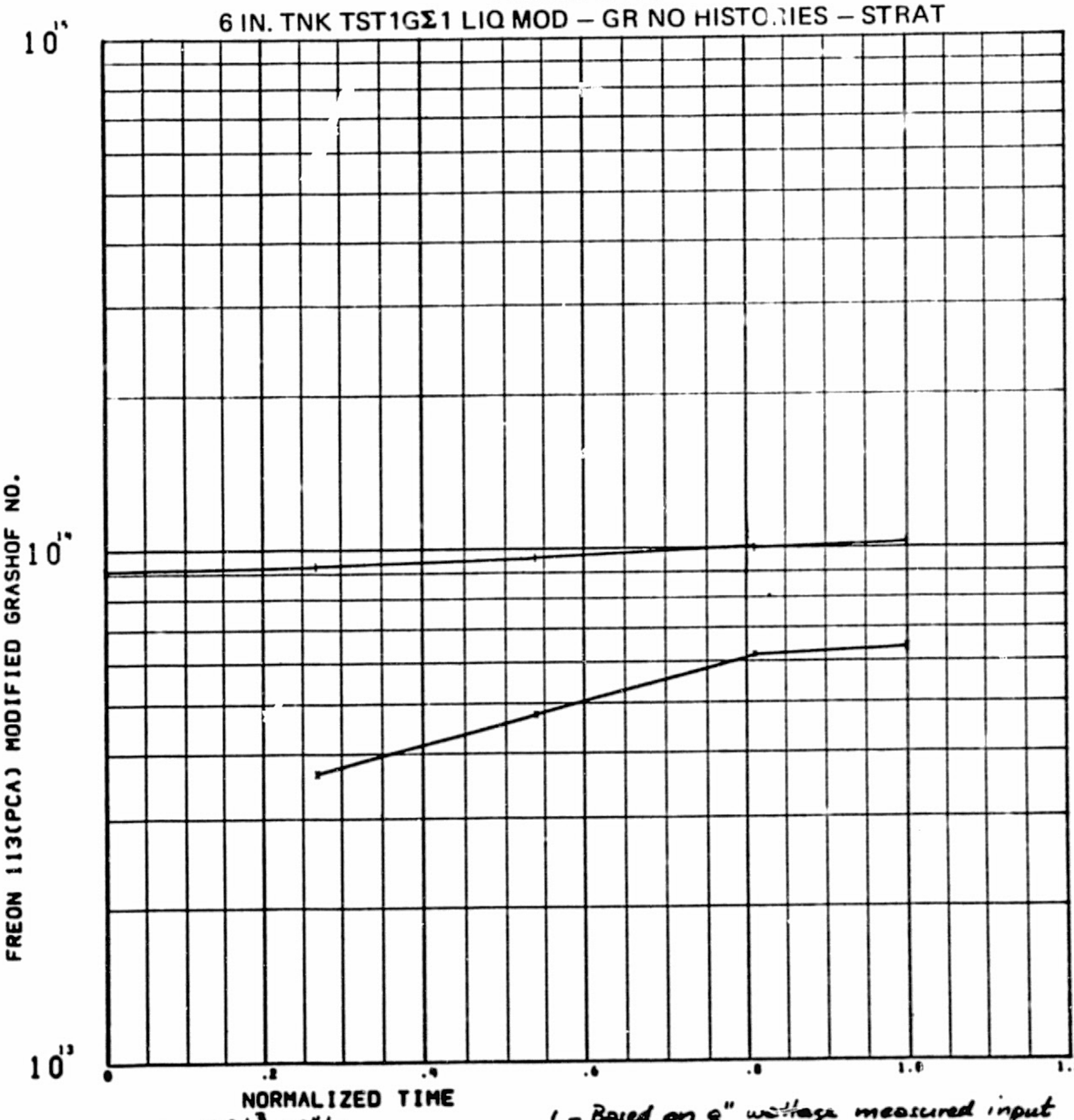
FIGURE 5.11-5b
6 IN. TNK TST1GΣ2 TANK PRESSURE HISTORY



2
3 > Transducer Measured

FIGURE 5.11-6a

6 IN. TNK TST1GΣ1 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_l^2}\left(\frac{q''L}{k}\right)$

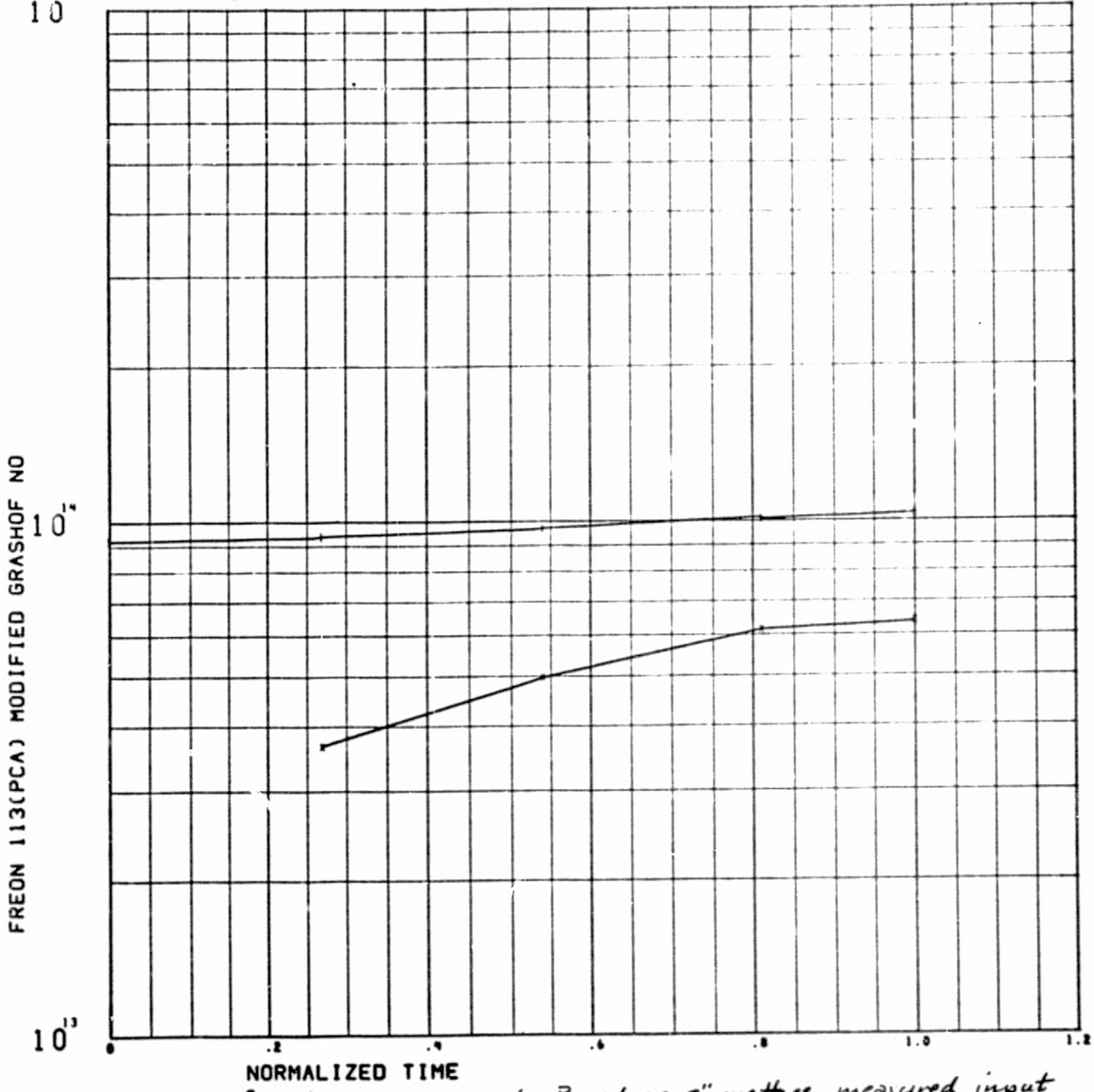
L = Fluid depth

I - Based on q'' wattage measured input

x - Based on experimentally absorbed q''_{fluid}

FIGURE 5.11-6b

6 IN. TNK TST1GΣ2 LIQ MOD – GR NO HISTORIES – STRAT



$Gr^* = \frac{g\beta L^3}{(\mu/\rho)_\ell^2}\left(\frac{q''L}{k}\right)$

L = Fluid depth

1 - Based on q'' wattage measured input

x - Based on experimentally absorbed q''_{fluid}

FIGURE 5.11-7a
6 IN. TNK 1GΣ1 LIQ FOURIER NO HISTORY

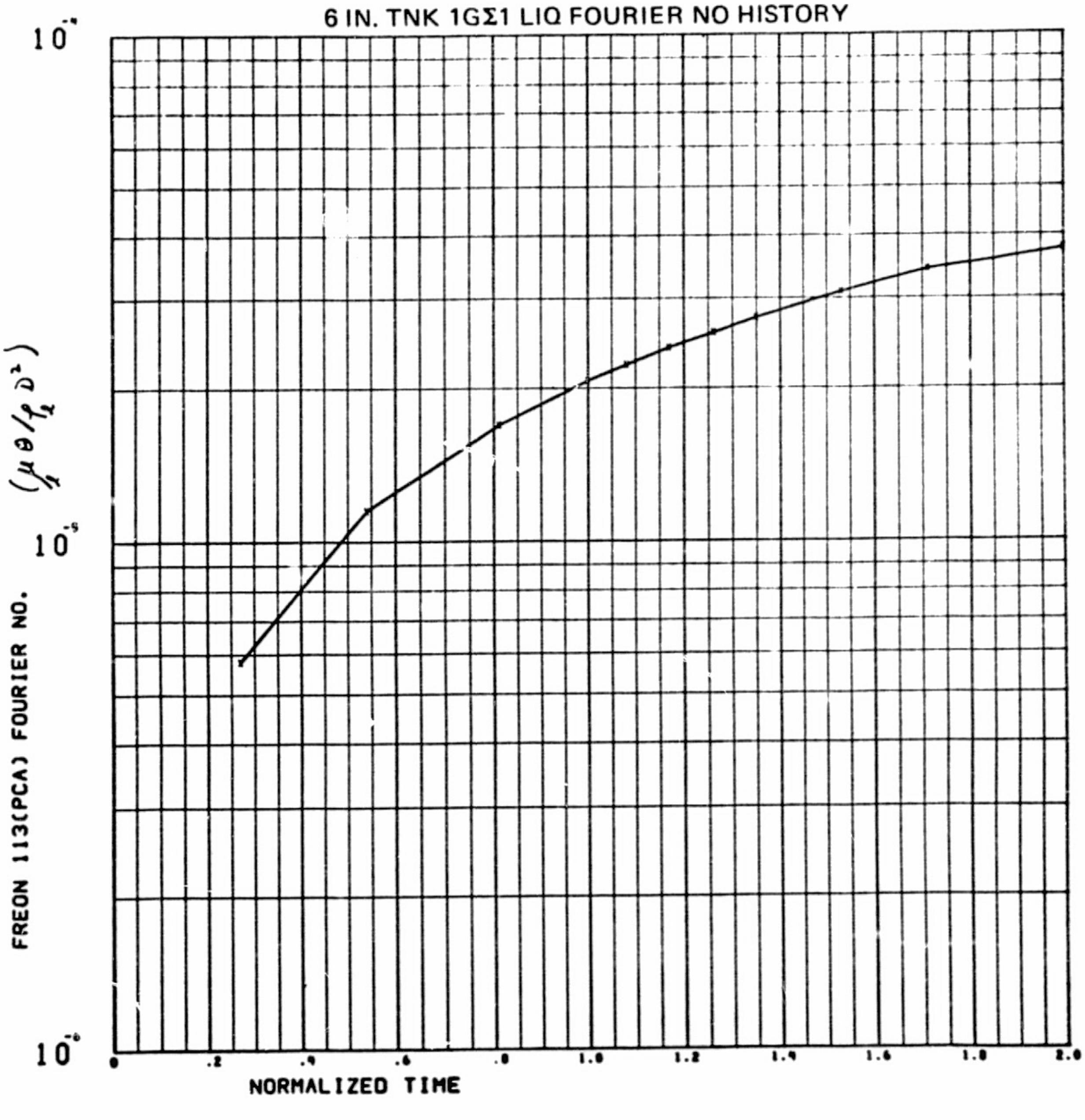


FIGURE 5.11-7b

6 IN. TNK 1GΣ2 LIQ FOURIER NO HISTORY